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RESEARCH

CHARACTERISTICS OF CROSMATCH TYPES IN COMPATIBILITY TESTING ON DIAGNOSIS AND BLOOD TYPES USING GEL METHOD

(Ciri Inkompatibilitas Uji Cocok Serasi Metode Gel terhadap Diagnosis dan Golongan Darah)

Irawaty, Rachmawati AM, Mansyur Arif

ABSTRAK

Pemeriksaan uji cocok serasi adalah pemeriksaan kesesuaian darah pasien dan donor. Pemeriksaan ini untuk mengetahui apakah antigen eritrosit donor sesuai dengan antibodi di serum pasien (uji mayor) dan antigen eritrosit pasien terhadap antibodi di serum donor (uji minor). Pemeriksaan uji cocok serasi dapat dilakukan dengan metode tabung (metode konvensional) dan Gel. Penelitian ini bertujuan untuk mengetahui ciri golongan darah dan diagnosis di inkompatibilitas uji cocok serasi dengan menggunakan metode Gel. Rancangan penelitian berupa observasional retrospektif di Bank Darah Rumah Sakit (BDRS) RSUP Dr.Wahidin Sudirohusodo Makassar dengan mengambil data Sistem Informasi Rumah Sakit (SIRS) dan data rekam medis masa waktu Juni 2013-Juni 2014. Jumlah keseluruhan 213 sampel dengan jumlah laki-laki 105 orang (49,3%) dan perempuan 108 orang (50,7%). Rentang umur terbanyak >17 tahun (83,6%). Kelompok di inkompatibilitas terbanyak di penyakit infeksi (36,2%) dengan golongan darah B (32,9%), rhesus positif (100%) dan tipe inkompatibilitas minor (81,2%). Pasien tanpa riwayat transfusi lebih banyak (97,7%) dibandingkan dengan riwayat transfusi (2,3%). Perlu diteliti lebih lanjut dengan anamnesis langsung di pasien untuk menghindari bias sehingga diperoleh hasil yang lebih sahih. Selain itu diperlukan penelitian lebih lanjut pemeriksaan penyaringan dan identifikasi antibodi di setiap ketidaksesuaian uji cocok serasi.

Kata kunci: Ciri inkompatibilitas, diagnosis, golongan darah

ABSTRACT

Cross matching is a method to investigate compatibility between recipients and donor blood. Furthermore, this method is applied for investigation of compatibility between donor's erythrocyte antigen and recipient' serum antibody (major test) and for investigation of compatibility between donor serum antibody and recipient's erythrocyte antigen (minor test). Cross matching may be performed using tube method (conventional) and gel method. To determine the characteristic of blood group and diagnosis in crossmatch incompatibility using Gel method. An observational study with retrospective approach has been done in blood bank Dr. Wahidin Sudirohusodo Hospital using data from Hospital information system and medical record from June 2013 until June 2014. Total 213 samples consisted of 105 males (49.3%) and 108 females (50.7%). Age groups >17 years old had a higher number for incompatibility (83.6%). Incompatibility was found also higher in infection group as the main diagnosis (77; 36.2%), B blood group (70; 32.9%), positive rhesus (100%) and minor incompatibility (81.2%). Samples from patients without transfusion history had a higher number of incompatibility (97.7%) than with transfusion history (2.3%). A further research by taking direct medical history from patient was suggested to avoid bias so the result of incompatibility would be more valid. A study for antibodies screening and identification for any crossmatch incompatibility was also suggestion.

Key words: Incompatibility type, diagnosis, blood group

INTRODUCTION

Blood transfusion is the administration of blood or blood components from a healthy donor to a recipient

who are in need. Blood consists of blood cells and plasma, blood cells consist of erythrocytes, leukocytes and hemoglobin. The administration of blood transfusions and blood components actually require

further examination of ABO and Rhesus (D), as well as cross match test to check donor's blood and patient's blood in order to be compatible to avoid agglutination or hemolysis reactions threatening patients and leading to death.¹

Thus, compatibility testing must be conducted to examine the compatibility of donor's blood and patient's blood. This examination aims to determine whether the erythrocytes of the donor's blood is in accordance with those of the patient's blood and whether there is antibody in the patient's serum (major test) or in the donor's serum against the patient's cells (minor test). This examination can be conducted using tube method (conventional method) and gel method.²

The compatibility testing using gel method was first discovered by Lapierre in 1990 at the *Regional Blood Transfusion Center of Lyon*. Gel technique consists of dextran acrylamide gel particles in micro-tubes and Coomb's serum. Its principle by reacting antibodies presented in the serum/plasma with antigens on erythrocytes in micro-tubes and then centrifuging to form agglutination. If the reaction is positive, it means that agglutinate is trapped in a gel. Meanwhile, if the reaction is negative, it indicates that antibody do not attach to erythrocytes and erythrocytes freely pass through the gel to the bottom of the micro tube.

The presence of agglutination actually indicates incompatibility. Thus, compatibility testing with gel method can be considered as a method with simple, fast and stable stages so that it can be documented and provide objective results.³⁻⁵ Procedure of the compatibility testing is divided into two stages, namely major compatibility examination in which the donor's erythrocytes are mixed with the patient's serum and minor compatibility examination in which the patient's erythrocytes are mixed with the donor's plasma.⁴

The International Society of Blood Transfusion (ISBT) has introduced 285 blood group antigens. ABO blood group system and rhesus blood group are the most clinically significant group system. A and B antigens are immunogenicall found in various body fluids, such as blood plasma, saliva and tears. ABO antibodies are formed naturally and can cause incompatible intravascular hemolysis transfusion. On the other hand, D antigen in Rh system is also immunogenic, but unlike the ABO system, this system does not have Rh antibodies formed naturally in human body.^{1,6}

Unfortunately, there still has not been any published research on characteristics of blood type and diagnosis in compatibility testing using gel method. Therefore, this research was conducted in the Dr. Wahidin Sudirohusodo Hospital. Finally, this research is expected to be a source of information about the characteristics of blood group and diagnosis in compatibility testing using gel method.

METHODS

This research was an observational study with retrospective approach undertaken in the Hospital Blood Bank (Bank Darah Rumah Sakit-BDR) in October 2014. This research used the medical record data and the Hospital Information System (SIRS) data of Dr. Wahidin Sudirohusodo Hospital, Makassar. Samples used in this research were all incompatible data of patients obtained from compatibility testing with gel method from June 2013 to June 2014. Next, a statistical analysis was conducted using SPSS 16.0 software.

In addition, the age of the subjects were divided into two groups, 1–17 years and >17 years. The cross match type then was also classified into major cross match, minor cross match, as well as major and minor cross match (bidirectional cross match). Next, diagnoses were also grouped by primary diagnosis into malignancy group, infection group, endocrine metabolic group, trauma group, congenital group, and other groups. Similarly, transfusion history was classified into groups with transfusion history and without transfusion history.

Moreover, diagnoses classified into malignancy group include hematologic malignancies, head neck tumors, breast tumors, lung tumors, nerves and connective tissue tumors, urinary tract tumors, gastrohepatobilier system tumors, and gynecological tumors. Diagnoses grouped into infection were *immunodeficiency* triggered by *Human Immunodeficiency Virus* (HIV) infection, respiratory tract infections, urinary tract infections, gastrohepatobilier system infections, musculoskeletal system infections, as well as infection caused by dengue virus and parasites. Diagnosis grouped into endocrine metabolic group included kidney failure, stroke, diabetes mellitus, electrolyte disturbances and encephalopathy. Diagnosis classified into trauma group were *trauma capititis*, fractures and urinary tract

trauma. Diagnosis including congenital group were congenital heart disease and congenital abnormalities of gastrointestinal tract. Finally, diagnosis classified into other groups were urinary tract stones, osteoarthritis and prostate hypertrophy.

RESULTS AND DISCUSSION

This research used all compatible data derived from compatibility testing using Gel method in Hospital

Blood Bank, medical records and Hospital Information System data of the Dr. Wahidin Sudirohusodo Hospital from June 2013 to June 2014. The number of samples obtained was 213, namely 105 males (49.3%) and 108 females (50.7%). The number of samples aged 1–17 years old was 35 (16.4%), while the number of samples aged >17 years old was 178 (83.6%). The number of samples classified into malignancy group was 63 (29.6%), infection group was 77 (36.2%), endocrine metabolic group was 60 (28.2%), trauma group was 6 (2.8%), congenital group was 3 (1.4%) and other groups was 4 (1.9%).

In addition, the number of samples grouped into blood type A was 66 (31%), blood type B was 70 (32.9%), blood type AB was 23 (10.8%) and blood type O was 54 (25.4%). All rhesus were positive (100%). The number of samples classified into major cross match was 14 (19.2%), minor cross match was 173 (81.2%) and major and minor (bidirectional) cross match was 26 (12.2%). The number of samples grouped into the group with a transfusion history was 5 (2.3%), while the group without a transfusion history was 208 (97.7%). Detailed data were shown in Table 1.

The incompatible data of sex characteristics can be seen in Table 2. Minor cross match was a type of cross match mostly found in both sexes with a percentage of 82.9% in males and 79.6% in females.

The age distribution of the incompatible group was (40 ± 19.1 years old) in which the youngest was 1 year old, while the oldest was 84 years old. The number of samples in the age group of 1–17 years old with major cross match was 4 (11.4%), the number of samples with minor cross match was 27 (77.7%) and the number of samples with major minor cross match was 4 (11.4%). Similarly, the same percentage was found in the age

Table 1. Characteristics of research subjects

Variables	n (%)
Number of subjects (n = 213)	
Age:	
1–17 years old	35 (16.4)
>17 years old	178 (83.6)
Sex:	
Male	105 (49.3)
Female	108 (50.7)
Diagnosis group:	
Malignancy	63 (29.6)
Infection	77 (36.2)
Endocrine metabolic	60 (28.2)
Trauma	6 (2.8)
Congenital	3 (1.4)
Others	4 (1.9)
Blood type:	
A	66 (31.0)
B	70 (32.9)
AB	23 (10.8)
O	54 (25.4)
Rhesus:	
Positive	213 (100)
Negative	0 (0.0)
Cross match type:	
Major	14 (19.2)
Minor	173 (81.2)
Major minor	26 (12.2)
Transfusion history :	
Yes	5 (2.3)
No	208 (97.7)

Table 2. Comparison of sex and major, minor, as well as major minor cross match

Sex	Cross match types			Total n (%)
	Major n (%)	Minor n (%)	Major minor n (%)	
Males	8 (7.6)	87 (82.9)	10 (9.5)	105 (100)
Females	6 (5.6)	86 (79.6)	16 (14.8)	108 (100)

Table 3. Comparison of age and major, minor, as well as major minor cross match

Age	Cross match types			Total n (%)
	Major n (%)	Minor n (%)	Major minor n (%)	
1–17 years old	4 (11.4)	27 (77.1)	4 (11.4)	35 (100)
>17 years old	10 (5.6)	146 (82.0)	22 (12.4)	178 (100)

group of >17 years old. The detailed data could be seen in Table 3.

Distribution of data in the diagnosis group based on primary diagnosis as shown in Table 4.

Diagnosis group of malignancy, infection and metabolic endocrine had a similar percentage of data distribution, while the trauma and congenital diagnosis had a similar percentage of data distribution. Diagnosis

Table 4. Primary diagnosis of subjects experiencing incompatible data

Diagnosis		Total
Malignancy	Hematologic Malignancies	34
	Head Neck Tumors	2
	Breast Tumors	1
	Lung Tumors	3
	Nerves and Connective Tissue Tumors	4
	Urinary Tract Tumors	4
	Gastrohepatobilier System Tumors	8
	Gynecological Tumors	7
Infection	<i>Immunodeficiency</i>	22
	Respiratory Tract Infections	18
	Urinary Tract Infections	10
	Gastrohepatobilier System Infections	17
	Musculoskeletal System Infections	5
	Infection caused by Dengue Virus and Parasites	5
Endocrine metabolic	Kidney Failure	43
	Stroke	3
	Diabetes Mellitus	6
	Electrolyte Disturbances	5
	Encephalopathy	3
Trauma	Trauma Capitis	2
	Fractures	1
	Urinary Tract Trauma	3
Congenital	Congenital Heart Disease	2
	Congenital Abnormalities of Gastrointestinal Tract	1
Others	Urinary Tract Stones	2
	Osteoarthritis	1
	Prostate Hypertrophy	1

Table 5. Comparison of diagnosis group and major, minor, as well as major minor cross matches

Diagnosis	Cross match types			Total n (%)
	Major n(%)	Minor n(%)	Major minor n(%)	
Malignancy	4 (6.3)	50 (79.4)	9 (14.3)	63 (100)
Infection	4 (5.2)	65 (84.4)	8 (10.4)	77 (100)
Endocrine metabolic trauma	3 (5.0)	48 (80.0)	9 (15)	60 (100)
Congenital	2 (33.3)	4 (66.7)	0 (0.0)	6 (100)
Others	1 (33.3)	2 (66.7)	0 (0.0)	3 (100)
	0 (0.0)	4 (100)	0 (0.0)	4 (100)

Table 6. Comparison of blood type and major, minor, as well as major minor cross match

Blood type	Cross match types			Total n(%)
	Major n(%)	Minor n(%)	Major minor n(%)	
A	4 (6.1)	57 (86.4)	5 (7.6)	66 (100)
B	3 (4.3)	55 (78.6)	12 (17.1)	70 (100)
AB	3 (13.0)	16 (69.6)	4 (17.4)	23 (100)
O	4 (7.4)	45 (83.3)	5 (9.3)	54 (100)

Table 7. Comparison of transfusion history and major, minor, as well as major minor cross matches

Transfusion history	Cross match types			Total n (%)
	Major n (%)	Minor n (%)	Major minor n (%)	
Yes	0 (0.0)	5 (100)	0 (0.0)	5 (100)
No	14 (6.7)	168 (80.8)	26 (12.5)	208 (100)

of others had minor cross match. Data could be seen in Table 5.

The most cross match type found in blood type group was minor cross match with blood type A percentage of 86.4%, type B percentage of 78.6%, type AB percentage of 69.6% and type O percentage of 83.3%. Data could be seen in Table 6.

All subjects with transfusion history had a minor cross match, whereas subjects without transfusion history were divided into three cross match groups. Data could be seen in Table 7.

This research found 109 males [48.7%] and 115 females [51.3%]. This indicated that there was no gender predominance in the compatibility testing. The number of samples which had an incompatibility most widely was found in the age group of >17 years old (178 people, 83.6%). This is likely because the population demand for blood in patients aged >17 years old was more than aged 1-17 years.⁷

The diagnosis group, which had the most incompatibility, was the infection group of 77 people (31.2%). The malignancy group, which the most showed incompatibility, was hematologic malignancies. Malignancy might be accompanied by changes in cell surface antigens. Some of these changes were caused by incomplete antigen synthesis or abnormal antigen synthesis that could cause neoantigens.⁸

Meanwhile, the group of infection, which the most had incompatibility, was *immunodeficiency*. This was due to the presence of autoantibodies in patients with HIV leading to incompatibility during the compatibility testing. B lymphocytes of people with HIV did not give an appropriate response resulting in formation of autoantibodies against some body proteins, such as erythrocytes and hemoglobin. The

formation of autoantibodies in HIV patients can pass through two mechanisms, namely the irregularities of B cell activation process resulting in polyclonal hypergammaglobulinemia and *molecular mimicry* between HIV antigens and erythrocytes causing agglutination reaction against erythrocytes of the patients themselves.^{9,10}

In addition, the endocrine metabolic group, which the most had incompatibility, was renal failure. The trauma group, which the most had incompatibility, was urinary tract trauma. The congenital group, which the most had incompatibility, was congenital heart disease. The others, which the most had incompatibility, were kidney stones.

Furthermore, the blood group mostly suffering from incompatibility was blood type B, about 70 people (32.9%). All the positive rhesus about 213 people suffered from incompatibility (100%). Antigens in the rhesus system are proteins encoded by two genes located on chromosome 1p36. RHD gene encodes antigen D, while RHCE gene encodes antigens C, c, E and e. Individuals with negative Rh do not have RHD genes or experience mutation in the gene that prevents the formation of antigen D.¹¹

Moreover, the cross match type mostly obtained was minor cross match about 173 people (81.2%). Examination of minor compatibility was conducted using donor serum and erythrocytes of patients to detect the compatibility of IgM and IgG antibodies in the donor serum.¹²

Finally, subjects mostly suffering from incompatibility were those without transfusion history, about 208 people (97.7%). Thus, because repeated transfusions can stimulate a secondary immune response and increase antibody titers rapidly after the

transfusions. As a result, the possibility of incompatible reactions were more common in patients who received transfusions with no repeated transfusion history.⁸ Subject obtained in this research were mostly without transfusion history since the data were taken from medical records, so it was difficult to obtain their transfusion history. Therefore, this research had many limitations. This research could not distinguish degrees of each cross match type and *grading* diagnosis. This research was also an observational study using the Hospital Blood Bank data, medical records and SIRS data, so it was difficult to avoid bias results.

CONCLUSION AND SUGGESTION

In this research, the most cross match type was minor cross match found in infection and blood type B groups. Thus, it should be investigated further with direct history of patients in order to avoid bias results. Finally, further research is also required to obtain proper screening examination and antibody identification for every compatibility testing.

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