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Choice of ABO Group for Blood Component Transfusion in ABO-Incompatible Solid Organ Transplantation: A Questionnaire Survey in Korea and Guideline Proposal

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The number of ABO-incompatible solid organ transplantations (ABOi SOTs) has markedly increased worldwide since the early 2000s. We investigated the choice of ABO group for blood component transfusion in ABOi SOT. We conducted a survey by e-mailing a questionnaire to blood bank specialists at 77 major hospitals in Korea, among whom 34 responded to the survey. In major ABOi SOT, for red blood cells (RBCs), the recipient's type (70.6%) was the most common choice, followed by group O (29.4%); for platelets, group AB (50.0%) was the most common choice, followed by the donor type (38.2%); for plasma, group AB (55.9%) was the most common choice, followed by the donor type (32.4%). In bidirectional ABOi SOT, for RBCs, the recipient's type (55.9%) was the most common choice, followed by group O (44.1%); for platelets and plasma, group AB was the most common choice (94.1% and 97.1%, respectively). The policies for transfusion in ABOi SOT were diverse. We suggest a guideline on the choice of ABO group for transfusion in ABOi SOT to secure patient health and enable an efficient use of blood components.

Key Words: ABO incompatible, Solid organ transplantation, Transfusion, Donor, Recipient, Blood component, Survey, Guideline, ABO blood group

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Since the adoption of methods, such as plasmapheresis, and administration of immunosuppressive drugs that can successfully prevent hyperacute rejection, the number of ABO-incompatible solid organ transplantations (ABOi SOTs) has markedly increased in many countries. In Korea, in 2018, major and bidirectional ABO-incompatible transplantation accounted for 26.3% (342/1,301) and 22.9% (253/1,106) of living-donor kidney and living-donor liver transplantations, respectively [1]. Blood banks play an important role in the success of ABOi SOT, because they are responsible for the supply of various blood components during the perioperative period, including plasma for plasmapheresis. To avoid donor organ rejection or hemolytic transfu-

sion reactions, it is important to select the appropriate ABO group for blood components. While transfusion guidelines for ABO-incompatible hematopoietic stem cell transplantation are well established [2], there is a lack of evidence-based guidance on blood component transfusion in ABOi SOT. To our knowledge, suggestions regarding the choice of ABO group for transfusion in ABOi SOT have been provided in only three sets of guidelines or textbooks [3-5], and the content and depth of the information given in these few existing publications differs. We investigated the ABOi SOT status in Korea and proposed guidelines on the choice of ABO group for blood component transfusion in ABOi SOT.

We conducted a survey from March to April 2020 by e-mailing a questionnaire to blood bank specialists at 77 major general hospitals in Korea. This study did not apply for ethics approval, as the information was based on professional opinion and did not involve clinical or animal experimentation. The survey items included information about the following: organs for which ABOi SOT was performed, average annual numbers of kidney and liver transplants, number of hospital beds, choice of ABO group for each blood component (red blood cells [RBCs], platelets, and plasma) for transfusion in major and bidirectional ABOi SOTs, duration of ABO non-identical transfusion after ABOi SOT, personnel who determine the ABO group for transfusion in ABOi SOT, and process for requesting blood components from blood banks in ABOi SOT. Additional descriptive survey questions were as follows: "(1) In case of transplanting organs of group A or B patients to group O patients, there are two opinions for the transfusion of platelets or plasma: platelets or plasma of group AB or that of the donor's ABO group should be given. Which of these opinions do you support and why?" and "(2) If you have any additional suggestions on the choice of ABO group of blood components for transfusion in ABOi SOT, please feel free to describe."

In total, 34 specialists performing ABOi SOTs at their hospital responded to the survey, and the major survey results are summarized in Table 1. For major ABOi SOT, the recipient's ABO group was the most common choice of ABO group for RBCs (70.6%), followed by group O (29.4%); group AB was the most common choice for platelets (50.0%) and plasma (55.9%). For bidirectional ABOi SOT, the recipient's ABO group was the most common choice of ABO group for RBCs (55.9%), followed by group O (44.1%); group AB was the most common choice for platelets (94.1%) and plasma (97.1%). ABO non-identical transfusion was maintained permanently in most of the hospitals (58.9%). Transfusion medicine specialists most commonly took the decision (70.6%) on the ABO group for transfusion in ABOi SOT. For the method for requesting blood components from the blood bank for transfusion in ABOi SOT, consultation with the transfusion medicine specialist was the most common answer (52.9%) (Table 2).

Table 1. Characteristics of the 34 respondents performing ABOi SOT

Variable	N (%)
Type of organ for which ABOi SOT was performed	
Kidney and liver	30 (88.3)
Kidney	3 (8.8)
Liver	1 (2.9)
Average annual number of kidney transplants	
>100 cases	6 (17.7)
51–100 cases	1 (2.9)
11–50 cases	17 (50.0)
<11 cases	9 (26.4)
Not performed	1 (2.9)
Average annual number of liver transplants	
>100 cases	5 (14.7)
51–100 cases	2 (5.9)
11–50 cases	13 (38.2)
<11 cases	11 (32.4)
Not performed	3 (8.8)
The number of hospital beds	
>1,500 beds	4 (11.8)
1,000–1,500 beds	7 (20.6)
500–999 beds	23 (67.6)

Abbreviation: ABOi SOT, ABO-incompatible solid organ transplantation.

For the descriptive question (1), approximately half of the respondents (19/34, 55.9%) answered "the donor's ABO group" for the transfusion of platelets or plasma; of these, 11 chose this answer due to the lack of group AB plasma and platelets. Eleven of the 34 (32.4%) respondents answered "group AB;" of these eight chose this answer due to the need for workflow simplification to minimize transfusion accidents. Three of the 34 (8.8%) respondents answered that both group AB and the donor's ABO group could be transfused, while one respondent of the 34 (2.9%) did not answer the question. For question (2), 11 respondents gave suggestions, nine among whom suggested a need for guidelines on the choice of ABO group for blood component transfusion in ABOi SOT. The other two respondents described difficulties in blood supply due to a shortage of group AB plasma.

This survey revealed that hospitals have different policies for

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Table 2. Policies for transfusion in ABO-incompatible solid organ transplantation among the 34 respondents

Variable	N (%)
Choice of ABO group for blood component transfusion in major ABOi SOT	
RBC	
Recipient's group	24 (70.6)
Group O	10 (29.4)
Platelets	
Group AB	17 (50.0)
Donor's group	13 (38.2)
Group AB or donor's group	2 (5.9)
Recipient's group	2 (5.9)
Plasma	
Group AB	19 (55.9)
Donor's group	11 (32.4)
Group AB or donor's group	3 (8.8)
Recipient's group except for plasmapheresis in which group AB plasma was transfused	1 (2.9)
Choice of ABO group for blood component transfusion in bidirectional ABOi SOT	
RBC	
Recipient's group	19 (55.9)
Group O	15 (44.1)
Platelets	
Group AB	32 (94.1)
Recipient's group	2 (5.9)
Plasma	
Group AB	33 (97.1)
Recipient's group except for plasmapheresis in which group AB plasma was transfused	1 (2.9)
Duration of ABO non-identical transfusion after ABOi SOT	
Permanent	20 (58.9)
Six months	1 (2.9)
Four weeks	4 (11.8)
Three weeks	1 (2.9)
Two weeks	3 (8.8)
Depending on the patients' condition	3 (8.8)
No criteria	1 (2.9)
No incompatible transfusion except for plasmapheresis	1 (2.9)
Personnel who determine the ABO group of blood components	
Specialist in transfusion medicine	24 (70.6)
Physician	5 (14.7)
Both by consultation	5 (14.7)
Process for requesting blood components from blood banks	
Consulting transfusion medicine specialist	18 (52.9)
Specific system for ABOi SOT other than consultation	8 (23.5)
By phone	6 (17.7)
No difference from general transfusion request	2 (5.9)

Abbreviations: ABOi SOT, ABO-incompatible solid organ transplantation; RBC, red blood cell.

blood component transfusion in ABOi SOT and that guidelines on the choice of ABO group for transfusion in ABOi SOT would be beneficial for clinical practice. We also found differences in the existing literature regarding the choice of ABO group for transfusion in ABOi SOT [3-5]. The recommendations of the British Society of Haematology (BSH) Guidelines on the spectrum of fresh frozen plasma and cryoprecipitate products [3] are summarized: following minor ABOi SOT, plasma components should be of the recipient's ABO group; following major ABOi SOT, plasma should be of the donor's ABO group until organ accommodation (usually four weeks after transplantation); and following bidirectional ABOi SOT, group AB plasma should be given until organ accommodation (usually four weeks after transplantation). These are grade 1C (strong) recommendations; however, they are based on low-quality evidence. The Australian and New Zealand Society of Blood Transfusion (ANZSBT) provides guidance regarding ABOi kidney transplantation, which relies on the understanding of the following basic principles of ABO incompatibility: during transplantation, recipients of a kidney from an ABOi donor should be transfused with blood products, particularly, plasma products, in which the ABO antibodies are compatible with the ABO group of the graft [4]. They also suggest that recipients should remain on their transplant transfusion protocol indefinitely, and specific product requirements should be determined in consultation with their nephrologist. Stotler, *et al.* [5] described that transfusion services should establish procedures to avoid the administration of plasma-rich blood components containing anti-A or anti-B antibodies directed against antigens expressed on donor organs. For example, they suggest a protocol utilizing not only group AB plasma and platelets, but also group A or B depending on the recipient and donor blood groups. One article describing the protocol used in a single institution in India suggested a relatively liberal use of group O RBCs and that the use of group AB plasma should be prioritized [6].

The transfusion of "universal" group AB platelets or plasma without consideration of donor and recipient ABO groups may be considered an easy way to avoid ABO antibody-mediated rejection; however, not only does it create problems, such as supply shortages, but it may also affect the quality of patient care [7]. Group AB plasma contains soluble A and B antigens that can bind to circulating anti-A or anti-B antibodies in the recipient, forming soluble high-molecular-weight immune complexes. These complexes can bind to RBCs, causing hemolysis, and to platelets, resulting in their activation and premature clearance from the circulation [8, 9]. Group O recipients transplanted with group A- or B-derived kidneys and transfused with "universal" group AB plasma reportedly had unfavorable outcomes when compared with group O recipients transplanted with group A- or B-derived kidneys and transfused with group A or B plasma identical to the donor's ABO group [10].

Table 3. Choice of ABO group for blood component transfusion in ABOi SOT (modified from Ref. [12] with permission)

Type of incompatibility	Recipient	Donor	RBCs		Platelets and plasma	
			First choice	Second choice	First choice	Second choice
Major	O	A	O	NA	A	AB
	O	B	O	NA	B	AB
	O	AB	O	NA	AB	NA
	A	AB	A	O	AB	NA
	B	AB	B	O	AB	NA
Bidirectional	A	B	A	O	AB	NA
	B	A	B	O	AB	NA

Abbreviations: ABOi SOT, ABO-incompatible solid organ transplantation; RBC, red blood cell; NA, not available.

Based on our survey results and previous publications, we suggest a guideline on the choice of ABO group for transfusion in major and bidirectional ABOi SOTs, considering the recipient's and donor's ABO groups (Table 3). For platelets and plasma, when group AB and the donor's ABO group are both compatible, based on serologic principles of ABO incompatibility, e.g., in cases of group O recipients and group A or B donors, we suggest transfusion of the donor's ABO group rather than group AB as the first choice. Not only would this help relieve the group AB plasma supply shortage, but it would also be prudent to deviate minimally from the donor's ABO group, considering the above-mentioned immunological problems. As for RBCs, we suggest transfusion of the recipient's ABO group rather than the routine use of group O as the first choice, as unnecessary infusion of anti-A or anti-B antibodies against the recipient may induce hemolytic reactions, and should be avoided whenever possible. The BSH and ANZSBT have suggested the use of ABO non-identical plasma up to four weeks after transplantation and indefinitely, respectively [3, 4]. Although the isoagglutinin titer in patients after ABOi kidney transplantation remains at a significantly lower level than the initial level after such treatment [11], we believe there is insufficient long-term evidence to support these suggestions. As the mechanism of accommodation is not yet fully understood, reverting to the use of the recipient type plasma should be cautiously contemplated. We hope that this

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guideline on the choice of ABO group for transfusion in ABOi SOT will contribute towards securing patient health and enable an efficient use of blood components in the era of unpredictable blood supply shortage, especially for group AB plasma.

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AUTHOR CONTRIBUTIONS

Chung Y summarized the data and wrote the manuscript. Ko D-H designed the study and provided advice regarding the research methodology. Lim J and Kim K-H critically revised and supported the study. Kim H designed and supervised the study. All authors have reviewed and approved the manuscript.

CONFLICTS OF INTEREST

The authors declare no potential conflicts of interest relevant to this article.

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