

The Guideline for Transfusion Practice

Initial Remarks

Blood transfusion therapy is highly effective when appropriately performed and, therefore, is largely applied.

Recently, dependent on the remarkable promotion of safety measures, the immune and infectious adverse reactions and/or complications of blood transfusion have decreased, and the safety of blood products increased significantly. However, complete eradication of adverse reactions/complications of blood transfusion is still difficult, and recently, severe adverse effects such as graft-versus host disease (GVHD), transfusion-related acute lung injury (TRALI), acute lung edema, sepsis due to *Yersinia enterocolitica* infection, as well as hepatitis virus or human immunodeficiency virus (HIV) transmission by transfusion of blood from donors in the “window period”*, transmission of human parvovirus B19 or prion have been focused. Moreover, although rare, fatal hemolytic reactions due to transfusion of blood group-incompatible blood products, still occur.

Taking these facts, for the implementation of measures for the appropriate and safe transfusion practice, actions based on the newest knowledge are required, as well as the performance of transfusion practice under supervision of an experienced and expert medical doctor, and preparation for emergency measures in case of adverse events is also essential.

Therefore, the “Guideline for the Appropriateness of Transfusion Practice” (Notification from the head of the Health Policy Department, the Ministry of Health, Labour and Welfare of Japan, official announcement number 502, dated 19/Sep/1989) was settled as the guideline for the safety measures of transfusion practice, including blood products collected in-hospital, to follow the actual standard techniques, and subsequently revised in 1999, and enacted as the “Guideline for Transfusion Practice”.

In the present revision of the guideline, the advances and developments of the blood transfusion field achieved after the last revision in 1999 were taken into consideration, as well as the various rules regulating the appropriate transfusion practice, such as the Article 8 of the “Law for the guarantee of stable provision of safe blood products” (Law number 160, 1956; partly amended in July, 2003), which defines the appropriate use of blood products and the collection and provision of information regarding safety of blood products as the obligation of medical staff, were re-analyzed and revised.

* Period of initial infection when antigen/antibody tests and the nucleic acid amplification tests are still negative.

I. Concept

1. Obligation of medical personnel

The medical personnel,

When using biological products, the medical personnel must realize on the need to pay special attention to the risk of infectious transmission (Based on “The basic principles for the

improvement of safety of blood products and guarantee of stable provision of blood products” (6 June 2008, Notification No. 326 from the Ministry of Health, Labour and Welfare of Japan) 6th and 7th items of Clause 9 of the “Law for the guarantee of stable provision of safe blood products”) and,

Provide adequate and sufficient information to the patient and/or the family regarding the effectiveness and safety of blood products, as well as other necessary information regarding their appropriate use, and obtain their understanding (i.e., informed consent) (The pharmaceutical affairs law (Law number 145, 1960)) 7th item of Clause 68), and

Record the name, address and other necessary information regarding the patients receiving biological products, and preserve the record for at least 20 years (The pharmaceutical affairs law, 3rd and 4th items of Clause 68, number 9).

2. Indication of blood transfusion

1) Objective

The main objective of blood transfusion is to replace the deficient blood component, either cellular components such as red cells or plasma components such as coagulation factors, when there is quantitative or qualitative deficit, and, consequently achieve improvement of clinical symptoms or signs.

2) Comparative analysis of risks and benefits of blood transfusion

Since blood transfusion involves a series of risks, there is need to analyze whether its benefits exceed the risks, and decide on the indication. The volume of transfusion should be the minimal amount necessary to obtain the effect, and excess transfusion must be avoided. Moreover, when other drugs or treatment modalities exist, improvement of clinical symptoms should be attempted avoiding blood transfusion.

3) Informed consent

Information regarding the following items related to blood transfusion must be given to the patient and/or the family, in comprehensive words, and after good understanding, the informed consent must be signed. A copy of the informed consent must be given to the patient and the original must be fixed to the patient’s chart (when electronic chart is used, the original document must be adequately preserved).

Necessary explanation items

- (1) The reason why transfusion is necessary
- (2) The type and volume of blood products to be transfused
- (3) The risks associated with blood transfusion
- (4) The possible adverse effects, the existence of a relief system for the victims of adverse reactions of blood transfusion, and the requirements for its application;
- (5) The existence of autologous blood transfusion as an alternative;
- (6) The need of testing for infectious diseases and of pre-transfusion blood sample storage;
- (7) Preservation of blood transfusion records and their use in case the retrospective (“look-back”)

analysis of infection is necessary;

(8) Other necessary information related to blood transfusion.

3. The blood transfusion practice

1) The type of blood products, the method and volume of transfusion

The necessary volume, the life-span, and the production rate vary among the various blood components and, in addition, their extracorporeal function (when preserved outside the body) is different from their usual function in human body. When transfusing a patient, it is necessary to consider, in addition to the patient's condition, the function of each blood component and, based on the numerical expected result to be achieved, decide on the type, volume, frequency and interval of transfusion.

2) Transfusion of blood components

To avoid the eventual adverse effects that may occur due to infusion of components other than the necessary one, to reduce the cardio-vascular overload, and to effectively use the limited resource (blood), transfusion of whole blood must be avoided, transfusing solely the necessary blood component at the minimum necessary volume.

3) Autologous blood transfusion

Autologous blood transfusion is the safest transfusion when performed at hospitals with appropriate management system, and its use in surgical patients (especially those receiving elective surgery) needing blood transfusion is strongly recommended. To promote "safe and appropriate blood transfusion", which is the aim of the "Law for the guarantee of stable provision of safe blood products", active promotion of autologous blood transfusion is essential, and hospitals where elective surgeries with blood transfusion are routinely performed are required to implement autologous blood transfusion as a standard medical practice.

4. Appropriate blood transfusion

1) Number of blood donors

To reduce the risk of blood-borne infection, the number of blood donors must be reduced at minimum, with measures such as the use of concentrated (high-unit) blood products. Combination of red cell concentrates (red cell in MAP solution) and fresh frozen plasma (FFP) for purposes other than reposition of red cells and coagulation factors must be strictly avoided. (Check the Criteria for the use of blood products).

2) The use of blood products

Fresh frozen plasma (FFP), red cell concentrates (CRC), albumin and platelet concentrates (PC) must be used in accordance with the Criteria for Indication of Blood Products for Transfusion.

3) The indication of blood transfusion and its record

To confirm the appropriate indication of blood transfusion, the reason of its indication, and the

basis for determination of the necessary volume must be registered at the patient's chart, as well as the pre- and post-transfusion findings, and the assessment of the effectiveness of blood transfusion.

II. The ideal management system of blood transfusion

For the performance of blood transfusion, each institution (hospital) must adopt their own management system according to their policy, but since many departments are involved in transfusion practice, the introduction of the following operating system is recommended.

1. Establishment of the hospital transfusion committee

The hospital transfusion committee, composed by the administrative staff and the medical/co-medical staff involved in blood transfusion, must be established at the hospital. The meetings of the committee must take place regularly, in an attempt to regularly inspect the appropriateness of transfusion practice, the selection of blood products (including plasma-derived products), the appropriate selection and quality control of transfusion tests, the transfusion procedures, to analyze the total use of blood products, the methods for the improvement of appropriate use of blood products, such as case studies, the reporting system of all accidents, adverse effects and complications of blood transfusion and the measures to prevent them, and the improvements achieved. The reports of the meeting must be prepared, preserved, and the decisions must be informed to whole hospital staff.

2. Appointment of the responsible medical doctor

A medical doctor responsible for the general transfusion practice of the hospital, as well as the supervision of the practical affairs must be appointed.

3. Establishment of a blood transfusion service

All hospitals committed to routine blood transfusion practice must establish a blood transfusion service, take actions on measures decided at the hospital transfusion committee, under supervision of the responsible medical doctor, and in addition to transfusion tests, must centralize the management of all affairs related to request, control and provision of blood products, concentrating all blood transfusion-related affairs to the transfusion service.

4. Assign transfusion-specialist laboratory technicians

Clinical (or health) laboratory technician with high expertise and knowledge in general transfusion practice (including transfusion tests and quality control) must supervise all transfusion testing affairs, and the establishment of a 24-hour duty system is desirable.

III. The safety of blood products

1. Anamnesis of blood donors

To guarantee safety of the donor and prevent transmission of blood-borne infection to the recipient, adequate anamnesis of the donor must be taken at the time of blood collection to eliminate those in high-risk of viral infection. Especially for human immunodeficiency virus (HIV) infection, it is necessary to eliminate donors with practices of high-risk contamination,

under the donor's understanding.

2. Testing of blood donors

All collected blood must be subjected to testing for blood group type ABO, Rho (D) antigen, and irregular antibody testing, including indirect Coombs test. Additionally, testing for HBs antigen, HBs antibody, HBc antibody, HCV antibody, HIV-1, 2 antibodies, HTLV-I antibody, NAT for HBV, HCV, HIV-1, 2, and serological test for syphilis and ALT (GPT) must be performed.

In addition to the above tests, the Japanese Red Cross Blood Center tests for human parvovirus B19. However, this test is not included in the criteria of biological products.

3. Cross-checking against the previous records

When multiple donations have been done by the same blood donor, all tests described above in 2. must be performed for each donation. If blood group type does not match the previous ones, another sample must be collected, re-tested, and the cause of mismatching analyzed and registered.

問 診 票

この問診票は、献血される方と輸血を受けられる方の安全を守るためにかがうものです。エイズ検査目的の献血は、血液を必要とする患者さんの安全のためにお断りしています。

| 質 問 事 項 | | 質 問 事 項 | |
|---------|--|--|---|
| 1 | 今日の体調はよろしいですか。 | はい・いいえ <input type="checkbox"/> はい <input type="checkbox"/> いいえ | |
| 2 | この3日間に注射や服薬をされましたか。 歯科治療（歯石除去を含む）を受けましたか。 | はい・いいえ <input type="checkbox"/> はい <input type="checkbox"/> いいえ | 9 今までに輸血や臓器の移植を受けたことがありますか。 |
| 3 | 今までに次の病気にかかったことがありますか。 または現在かかっていますか。 マラリア、梅毒、肝臓病、乾せん、心臓病、脳卒中、 血液疾患、がん、けいれん、腎臓病、糖尿病、結核、 せんそく、アレルギー疾患、外傷・手術、 その他（ ） | はい・いいえ <input type="checkbox"/> はい <input type="checkbox"/> いいえ | 10 B型やC型の肝炎ウイルス保有者（キャリア）と言われたことがありますか。 11 次のいずれかに該当することがありますか。 ①CJD（クロイツフェルト・ヤコブ病）及び 精神疾患と医師に言われたことがある。 ②血縁者にCJD及び神経疾患と診断された人がいる。 ③人由来成長ホルモン注射を受けたことがある。 ④角膜移植を受けたことがある。 ⑤硬膜移植を伴う脳外科手術を受けたことがある。 |
| 4 | 次の病状や症状がありましたか。 3週間以内—はしか、風疹、おたふくかぜ、帯状疱疹、水痘 1カ月以内—発熱を伴う食中毒の激しい下痢 6カ月以内—伝染性単核球症 | はい・いいえ <input type="checkbox"/> はい <input type="checkbox"/> いいえ | 12 女性の方：現在妊娠中、または授乳中ですか。 この6カ月間に出産、流産をしましたか。 |
| 5 | この1カ月間に家族にA型肝炎やリンゴ病（伝染性紅斑）を 発症した人はいいますか。 | はい・いいえ <input type="checkbox"/> はい <input type="checkbox"/> いいえ | 13 エイズの検査を受けるための献血ですか。 14 この1年間に次のいずれかに該当することがあります たか。（該当する項目を選ぶ必要はありません） ①不特定の異性と性的接触をもった。 ②男性の方：男性と性的接触をもった。 ③エイズ検査（HIV検査）で陽性とされた。 ④麻薬・覚せい剤を注射した。 ⑤①～④に該当する者と性的接触をもった。 |
| 6 | この1年間に予防接種を受けましたか。 1980年（昭和55年）以降、海外に旅行または住んでいたこと はありますか。（国・都市名 ） ①それはどのくらいの期間ですか。（ ） ②いつ（昭和55年）～1996年（平成8年）の間に英国に1 年以上滞在しましたか。（はい・いいえ） | はい・いいえ <input type="checkbox"/> はい <input type="checkbox"/> いいえ | |
| 7 | | はい・いいえ <input type="checkbox"/> はい <input type="checkbox"/> いいえ | |
| 8 | この1年間に次のいずれかに該当することがありましたか。 ①ピアス、またはいれずみ（刺青）をした。 ②使用後の注射針を誤って自分に刺した。 ③肝炎ウイルス保有者（キャリア）と性的接触等親密な 接触があった。 | はい・いいえ <input type="checkbox"/> はい <input type="checkbox"/> いいえ | |

(注意) 1. 献血される方は、「はい・いいえ」欄の該当する方に ■ 印を
ご記入願います。

2. それ以外の欄には、問診を行う者が、必要事項を記入いたします。

回答訂正番号 番

私は以上の質問を理解し、正しく答えました。
献血した血液について、梅毒、HBV（B型肝炎ウイルス）、HCV
（C型肝炎ウイルス）、HIV（エイズウイルス）、HTLV-I
（ヒトTリンパ球白血病ウイルス-I型）等の検査が行われることを
了解し、献血します。

署 名

4. Preventive measures against adverse reactions/complications

1) Concentrated (high-unit) blood products

To decrease the chance of antigenic sensitization and transmission of infectious agents, concentrated blood components, i.e., red cell concentrates (2 units) or apheresis-derived fresh frozen plasma (FFP) or platelet concentrates, should be indicated whenever possible.

2) Irradiation

To prevent graft-versus host disease (GVHD), a fatal complication of blood transfusion, all blood products containing lymphocytes must be irradiated. The minimum of 15Gy (not exceeding 50Gy) must be applied to the total irradiation field. Since 1998, the Japanese Red Cross Blood

Center provides irradiated blood products, and since 2000, no definite cases of GVHD have been reported in Japan, using irradiated blood products. However, since K⁺ concentration increases in sera of irradiated blood products (including whole blood), they should be transfused as soon as possible after irradiation, especially when indicated to newborns, premature infants, infants, patients with renal failure and patients receiving massive transfusion in short period of time.

IV. Patient's blood group testing and screening of irregular antibodies

To prevent transfusion of incompatible blood products, the hospital performing blood transfusion must test the patient for the following:

1. ABO blood group

1) Direct (red cell) test and serum testing

The ABO blood group must be tested by both the direct (red cell) test in which the patient's red cells are tested for the presence/absence of A and B antigens, using anti-A and anti-B globulins, and the serum testing in which the patient's serum is tested for the presence/absence of anti-A and anti-B antibodies, using blood group A and B red cells. When agreement of both test results is obtained, the blood group type is fixed, and when not, the reason of disagreement must be investigated.

2) Double-check of the same patient

Blood group testing must be performed at least twice, using blood samples from the same patient collected at different times.

3) Double-check of the same blood sample

The same blood sample must be tested independently by two examiners, performing double- and cross-checking.

2. Rho (D) antigen testing

Patient's red cells must be tested for the presence/absence of Rho (D) antigen, using the anti-D globulin. When the test is negative, confirmation test is not necessary, and the patient must be manipulated as D antigen-negative.

3. Screening of irregular antibodies

Screening test of irregular antibodies, including the indirect Coombs test, must be performed. When antibody is detected, the identification test must be performed. In case a clinically relevant (possibility of causing adverse effects) warm-reactive antibody (reactive at 37°C) is detected, an identification card containing this information should be given to the patient, who must always hold it.

4. Blood group testing of small infants

Sera of infants within 4 months after birth may either contain maternally derived antibodies or contain low levels of anti-A and anti-B antibodies due to insufficient production, and therefore, direct (red cell) test suffices for blood group testing. Rho (D) antigen testing and testing of irregular antibodies are performed as described above in 2. and 3., but testing of irregular antibodies may be done using the mother's sera instead of the infant's.

V. Compatibility test for prevention of blood group type incompatible transfusion and other remarks

The compatibility test includes ABO blood group testing, Rho (D) antigen test, screening of irregular antibodies, and the cross-match test performed prior to transfusion.

1. Methods of transfusion tests

1) Blood group testing and screening of irregular antibodies

ABO blood group testing and Rho (D) antigen testing are performed as described in IV-1, 2, and screening of irregular antibodies as described in IV-3.

2) Cross-matching

(1) Collection of patient's blood sample

As a rule, blood sample collected separately from that for ABO blood group testing must be used for cross-matching.

(2) Selection of the blood for transfusion

Patient's ABO-identical blood products (referred below as ABO-compatible blood) must be used for cross-matching. Additionally, when the patient is Rho (D)-negative, blood products of the same ABO group and Rho (D)-negative products must be chosen. When the patient's serum contains a clinically relevant warm-reactive (at 37°C) irregular antibody, blood products without the corresponding antigen must be chosen.

(3) Procedures

The cross-matching test consists of the "main test", in which the patient's serum and the blood product's red cells are reacted, and the "supplemental test", in which the patient's red cells are reacted against the product's serum. Both tests check for the presence of cell agglutination or hemolysis. The "main test" can never be omitted.

Appropriate procedures, including the indirect Coombs test, which allow the check the ABO-incompatibility and additionally the detection of clinically relevant warm-reactive (at 37°C) irregular antibodies, must be chosen. Excluding the condition described in 3.2) below, incompatible blood at the "main cross-matching test", due to clinically relevant irregular antibodies, can not be transfused.

(4) Computer cross-match

When blood group compatibility as well as absence of clinically significant irregular antibodies have been confirmed by the ABO-typing, Rho (D) typing and screening of irregular antibodies, the cross-matching test can be omitted, and transfusion can be performed after confirmation of ABO-compatibility.

Computer cross-match is the method to confirm the above compatibility, which helps eliminate the risk of human error, rationalize the procedures, and additionally, is labor-saving, and can be performed when all the below requirements are fulfilled, as follows:

A warning message appears in case of an incompatible result or the blood product selection is inadequate;

The patient's blood group is tested at least twice using different blood samples;
The product's blood typing was re-checked;

(5) Selection of units (blood) for small infants

Even for infants within 4 months after birth, as a rule ABO-compatible blood must be chosen, and when red cells of blood group type other than O are to be used, the patient's serum must be checked for the presence/absence of anti-A and/or anti-B antibodies by cross-matching ("main test"), including the indirect Coombs test, and compatible blood must be selected. Moreover, when irregular antibody is detected, the procedures described above in (1) and (2) must be followed.

(6) Local of blood testing for transfusion

Excluding special cases, the cross-matching test should be performed at the hospital where the patient is going to receive blood transfusion.

2. Blood transfusion in urgent situations

For emergency patients in shock state, needing urgent replacement of red cells, blood sample collection for transfusion testing must be immediately attempted, but in case sample collection is unfeasible, the bled blood can be tested. The selection of units must be as described above according to the case, but as the general rule, when the patient's blood group type is undetermined, blood group type O red cells (but not whole blood) must be chosen, and ABO-compatible units chosen when blood group type is determined.

1) Use of ABO-compatible units for cases with determined ABO type

The patient's most recently collected blood sample must be tested for ABO and Rho (D) antigen typing, and ABO-compatible red cells (or whole blood) must be transfused. The cross-matching test should be performed simultaneously.

2) Use of blood group O units for cases with undetermined blood group type

When there is no enough time for blood typing due to shock state, or there is shortage of compatible blood, or blood typing reagent is lacking in the emergency service, or blood group type confirmation is not feasible, exceptionally, blood group type O red cells (but not whole cells) can be transfused.

Note: When transfusion is to be changed from blood group type O to the patient's ABO-compatible (patient's own ABO group) one after a certain amount of blood group type O red cells have been transfused, the patient's blood type and the cross-matching test by the "main test" of saline technique (immediate-spin technique, at room temperature), must be performed using the most recently collected blood sample, and the compatible unit must be chosen.

3) In case of Rho (D) antigen negative

When Rho (D) antigen is confirmed to be negative, effort must be done to select Rho

(D)-negative units. Giving priority to selection of Rh-compatible units, ABO-mismatched compatible components may be chosen. Especially in case of young or fertile women who receive Rho (D)-positive units, transfusion must be converted to Rho (D)-negative as soon as possible. Additionally, when irregular antibody testing performed within 48 hours is negative, intravenous anti-D immune globulin injection should be considered.

Note: The frequency of Rho (D)-negative among Japanese is 0.5%.

4) Explanation on and record of the reasons

In case of an urgent need for blood transfusion, in which uncross-matched units had to be used or group O units were transfused to blood group type undetermined patients, the medical doctor in charge must, after completion of the emergency treatment, explain to the patient or the family, in comprehensive words, the reasons of the procedure, the possible adverse effects, and must obtain the informed consent, and record the details in the patient's chart.

3. Compatible blood in case of patients receiving massive transfusion

Massive transfusion is defined as the infusion of a volume of blood approximating the recipient's total blood volume within a 24-hour period. Depending on the volume and speed of blood loss, the following procedures must be taken.

1) Cross-matching test for additional transfusion units

For patients receiving massive intra-operative transfusion in which additional transfusion units are necessary, usually there is not enough time for cross-matching by the indirect Coombs test. In such cases, at least the "main test" of the simplest serologic cross-matching method, the saline technique (immediate-spin technique, at room temperature), must be performed, in an attempt to avoid ABO-incompatible transfusion. Eventually, when there is shortage of ABO-compatible units, follow procedure 2-2), or if the patient is Rho (D)-negative, follow 2-3), but special attention must be paid to 2-4). For cross-matching, the most recently collected blood sample must be used whenever possible.

2) When irregular antibody is present

In cases needing urgent massive transfusion, even if clinically significant irregular antibody has been previously detected, and antigen-compatible units are not available, ABO-compatible units must be chosen, as in procedure 1) above, and after successful patient's resuscitation, the patient must be followed paying special attention to the development of hemolytic reactions.

3) Blood transfusion as a measure for patient's resuscitation (life-saving measure)

In the event of massive transfusion in cases such as hemorrhagic shock, sometimes the stock of ABO-compatible blood is not enough. In such cases, as a life-saving measure, mismatched compatible (including group O red cells) components should be chosen. However, it must be performed under strict observance of item 3-1).

| Patient's ABO type | Mismatched compatible red cells |
|--------------------|---------------------------------|
| O | None |
| A | O |
| B | O |
| AB | O, A, B |

[When patient's ABO type is unknown]

Blood group type O

4. Omission of cross-matching test

1) Selection of red cells or whole blood

When the donor's blood type is confirmed, and the screening of irregular antibodies, including indirect Coombs test, is negative and, in addition, the recipient's blood type is adequately determined, the "supplemental cross-matching test" for ABO-compatible blood can be omitted.

2) Case of small infants

Under the same conditions to 1) above, the "supplemental cross-matching test" for ABO-compatible blood can also be omitted in infants within 4 months after birth, in whom anti-A or anti-B antibodies are not detected and irregular antibodies are absent. Additionally, the mother's sera, instead of the infant's, can be used for the screening of irregular antibodies.

3) Selection of platelet concentrates and fresh frozen plasma

Cross-matching test can be omitted when transfusing platelet concentrates and fresh frozen plasma, which contain only small amounts of red cells. However, as a rule, ABO-compatible units must be used.

When the recipient of platelet transfusion is a Rho (D)-negative fertile woman, Rho (D)-negative units must be chosen whenever possible. If Rho (D)-positive platelet concentrate is transfused, the anti-D immune globulin injection can help preventing anti-D antibody production.

5. Handling of patient's blood samples

1) Time of blood sample collection

Since blood transfusion and pregnancy may result in production of irregular antibodies, when the recipient has a past history of blood transfusion or pregnancy within 3 months, or when these facts are unknown, the use of blood sample collected within 3 days of transfusion is recommended for cross-matching.

2) Double-check using different blood samples

The blood sample for cross-matching must be a newly collected one, separately from that used for blood typing, and must be typed for blood group simultaneously to cross-matching.

6. Measures other than blood testing to prevent incompatible transfusion

1) Avoid misidentification of blood samples at the time of collection

Misidentification of blood samples at the time of collection is a cause of mistyping and,

therefore, blood typing must be performed at least twice using samples collected in different occasions, and when there is agreement of both test results, the blood group type is determined. Sample misidentification may be dependent on blood collection from the wrong patient (mistakes due to homonyms, shared rooms, simultaneous blood collection from multiple patients, etc.) or mislabeling of the sample. To prevent the former, the use of a patient identification system at the time of collection is essential. The latter can be prevented by measures such as avoiding handwritten labels, and simultaneous multiple collections. Standing of test tubes from various patients in the same rack may result in tubes exchanging, and therefore, must be avoided. Single patient's tube in the single rack at the time of blood collection is mandatory.

2) Attention must be paid to avoid mis-transfer or mis-input of the data

Even when blood typing is correctly performed, there is risk of mistakes during transfer of data to the slip or inputting the data. Thus, double-check of the data by two different laboratory personnel is recommended. Additionally, checking the data input by a computer system should also be effective.

3) Record of results and notification to the patient

The blood typing results should not be transferred, but be directly fixed to the patient's chart, and the patient should be notified on the results paying special attention to the protection of personal information.

4) Attention must be paid to the risk of mistyping due to transfer error of previous results or verbal transmission of incorrect information.

When using the previous blood typing results, there is risk of error during transfer of the data results from the patient's chart, as well as the risk of error during verbal transmission of the data by phone. Transfer or verbal transmission may be the cause of mistyping and, therefore, the original test result fixed at the patient's chart must always be checked.

VI. Preparation of blood for elective surgery or non-urgent transfusion cases

To avoid unnecessary blood preparation, and to improve routine transfusion practice, the blood typing - irregular antibody screening method (type & screen, T&S) and the Maximum Surgical Blood Order Schedule (MSBOS) are recommended methods for preparation of blood units in non-urgent transfusion cases, including elective surgery patients.

1. Blood typing - irregular antibody screening method (Type & Screen, T&S)

In non-urgent transfusion cases, including elective surgery patients, the recipient can be previously typed for ABO group and Rho (D) antigen and checked for the presence of clinically relevant irregular antibodies and, if the recipient is Rho (D)-positive, and negative for irregular antibodies, blood units can be prepared without prior cross-matching. When transfusion becomes necessary, only the direct (red cell) test for ABO group or the "main test" of the simplest cross-match (immediate-spin saline technique, at room temperature) is performed to check ABO-compatibility, and transfusion is performed. Or eventually, the blood units with blood type previously confirmed by the direct (red cell) test is checked

against the recipient's blood type using the computer (computer cross-matching), and transfusion can be performed.

2. Maximal Surgical Blood Order Schedule; MSBOS)

For elective surgery patients, who certainly will need blood transfusion, each institution (hospital), based on the data of past surgical blood use, may obtain for each surgical procedure the volume of transfused (T) and the cross-matched blood (C) to calculate the C/T ratio to be up to 1.5, which is the ideal maximum number of units that may be ordered and prepared cross-matched for common elective surgical procedures.

3. Surgical Blood Order Equation ; SBOE

Recently, equations based on the patient's own data are proposed as more effective methods of blood preparation. SBOE is calculated based on the recipient's pre-operative hemoglobin levels (Hb), the recipient's tolerable levels without blood transfusion (trigger level: Hb 7-8g/dl), and the average number of units transfused in each surgical procedure, and the predictive number of units is obtained for each patient. Initially, the patient's tolerable levels without transfusion, i.e, the Hb level at which blood transfusion should be started is subtracted from the recipient's pre-operative Hb level, giving the patient's tolerable volume of bleeding (reserve volume) according to the patient's general condition. The patient's reserve volume is subtracted from the average number of units transfused in each surgical procedure, and converted into the expected blood units. As a result, if a negative value or value <0.5 is obtained, T&S should be indicated, and in case of value >0.5 , the value should be round off, and the integral number of units should be prepared.

VI. The ideal system of transfusion practice

The above procedures must be followed to achieve the safe and effective transfusion practice without errors.

Additionally, the existence of a well-known (by the house staff) and strictly followed manual of blood transfusion practice containing the check points of transfusion is essential. (refer to the manual of blood transfusion practice)

1. Pre-transfusion

Each blood product must be preserved at the most appropriate condition. Red cells and whole blood are preserved at 2°C - 6°C , in refrigerators, fresh frozen plasma at -20°C , in freezers with exclusive use for blood products, equipped with temperature charts and recorder, and an alarm system board.

Platelet concentrates should be transfused as soon as possible. Storage should be at room temperature (20 - 24°C) in flat-bed agitators.

2. Method of preservation of blood products

Under conditions of inadequate temperature control, blood components quickly lose their function, and can not be diverted to other patients. The storage and control of blood products

must be centralized to the blood transfusion service. As a rule, blood products should not leave the transfusion service (even to in-patient or the surgical center) unless immediately prior to use. After leaving the blood transfusion service, blood products must be used as soon as possible, and in case more than 30 min until the start of transfusion is expected, they must be preserved at the same conditions as described above in 1).

Note: Concerning storage and control of blood products, refer to the “manual for the storage and control of blood products” (Pharmaceutical and Medical Safety Bureau, Ministry of Health, Labour and Welfare, 16/Sep/1993).

3. External check of blood products

The medical doctor or nurse enrolled in blood transfusion must pay special attention to the potentially fatal bacterial contamination of platelet concentrates, since they are stored at room temperature. The external check of these products by naked-eye, which includes color change, presence of hemolysis or aggregates, as well as the presence of bag damages or breaking of the close system, is essential. Moreover, red cell concentrates must be checked for the presence of *Yersinia enterocolitica* infection, and in addition to the above parameters, the color of blood in the bag must be compared against that in the segment.

4. Single patient per time

As a rule, the preparation of blood products must be done each single patient per time. Simultaneous preparation of blood for multiple patients followed by transfusion increases the risk of errors, and should be avoided.

5. Items to be checked

To prevent blood group-incompatible transfusion due to procedure errors, the patient’s name in full, blood group type, lot number of blood product, expire date, result of cross-matching test, and irradiation status must be checked at the time of blood product provision (delivery), preparation for and initiation of transfusion, and cross-checked by using the cross-matching record, the label on the bag, and the slip attached to the bag, and confirm the appropriateness of the units to the patient. When the patient is anesthetized and unable to check by him/herself, the cross-checking of the appropriateness of the units to the patient by multiple medical personnel in charge is essential.

6. Importance of cross-checking

For the cross-checking, the above check items must be read and verbalized by 2 medical personnel in charge, by turns, and the fact must be recorded.

7. Homonyms

Although not common, homonyms or patients with very similar names may receive transfusion

at the same day. The patient's ID number, birth date, age and other identifying personal information must be routinely kept in mind.

8. Checking and cross-checking by electronic devices

For the assurance of adequate checking and cross-checking procedures, use of electronic devices such as the Personal Digital Assistant (PDA) to check the patient's identification wristband against the blood product is recommended.

9. Additional blood ordering

When additional blood ordering is necessary, the above procedures 3) – 8) must be correctly followed for each new blood ordered.

10. Patient observation at the time of starting blood transfusion

Before starting blood transfusion, the patient's body temperature, blood pressure, pulse and, when possible, transcutaneous arterial oxygen saturation should be checked, and after starting transfusion, the same parameters should be measured again in case adverse reaction occurs.

2. During blood transfusion

1) Observation of the patient immediately after blood transfusion is started

The speed of red cells infusion to conscious recipient must be slow at the start of transfusion. In ABO-incompatible transfusion, symptoms such as vessel pain, unpleasantness, chest and abdominal pains may occur immediately after starting the infusion. Therefore, observation of the patient at the bedside during the initial 5 minutes is necessary.

Patients receiving resuscitative (life saving) emergency transfusion are frequently unconscious and symptoms suggestive of incompatible transfusion may not be present. Therefore, effort must be done for the early diagnosis of incompatible transfusion by checking the general signs such changes in the ventilatory or circulatory status, the urine color changes by urethral catheterization, or by careful observation of the bleeding status at the surgical field.

2) Observation of the patient during blood transfusion

The patient's condition must be checked again 15min after transfusion is started. After the absence of early hemolytic reaction is confirmed, the patient must be carefully observed for the presence of febrile or allergic reactions, which occur quite frequently, to make the diagnosis in the early stage.

3. Post-transfusion period

1) Items to be checked

After transfusion is finished, the patient's name, blood group type and the lot number of the transfused unit must be re-checked, and the lot number must be recorded to the patient's chart.

2) Observation of the patient

After transfusion is finished, symptoms or signs of severe adverse reactions such as transfusion-related acute lung injury (TRALI) and bacterial infection may appear and, therefore, a system for the continuous observation of the patient in the post-transfusion period is necessary.

4. Preservation of the patient's blood sample

For the preservation of the patient's sample, the "Guideline for the retrospective ("trace-back") investigation related to blood products" (10/Mar/2005, Official announcement No. 0310012, Pharmaceutical and Medical Safety Bureau, Ministry of Health, Labour and Welfare, partially revised in 26/Dec/2008) must be followed. Following, part of the guideline is extracted and summarized.

When the hospital does not perform pre- and post-transfusion tests according to the concerned guideline (VIII-1-2) and (2)-ii. and -iii.), the recipient's pre- and post-transfusion blood samples (approximately 2ml of centrifuged plasma sample or serum/plasma (separated from red cells) from the samples used for cross-matching) should be collected and preserved at less than -20°C for a period of time, and when requested by the Japanese Red Cross Blood Center, the tests must be performed according to the guideline. Care should be taken to avoid contamination of the sample, by measures such as the use of disposable pipets. Additionally, when pre- and post-transfusion tests are performed according to the concerned guideline, re-testing may be necessary in cases such as the suspect of false-positive results or of reactivation of a latent viral infection. Thus, if the recipient's serum/plasma samples collected 1) approximately 1 week prior to transfusion and/or 2) 3 months after transfusion are available, they should be provided to the Japanese Red Cross Blood Center to cooperate in the investigation (excluding cases receiving blood units collected in-hospital).

The above samples should meet the following criteria: centrifuged plasma sample or serum/plasma obtained by centrifugation (separate from red cells) of a cross-matching sample, volume of approximately 2ml, preserved at less than -20°C, and for periods longer than 3 months (2 years as a guide) is recommendable.

VIII Adverse effects/complications of transfusion (blood products) and their preventive measures

Adverse effects/complications of blood transfusion may be of immunologic, infectious or other causes, and furthermore, can be classified as early-onset (or acute) and late-onset depending on the time of onset. The patient must be carefully observed, followed, and tested when necessary for the development of adverse reactions/complications, not only at the time of starting and during transfusion, but also after its completion.

When adverse effect/complication is diagnosed, it must be immediately reported to the transfusion service or to the hospital transfusion committee, records must be taken, and the cause must be investigated, taking preventive measures for its recurrence. Especially in case of human

errors (patient/sample misidentification, data transfer error, testing error, sample collection error, etc.), the cause of error and the preventive measures taken must be recorded in details.

1. Outline of adverse effects
 - 1) Hemolytic transfusion reactions
 - (1) Early-type (or acute) adverse effects
 - (2) Delayed-type adverse effects
 - 2) Non-hemolytic transfusion reactions
 - (1) Early-type (or acute) adverse effects
 - i. Bacterial infection
 - ii. Transfusion-related acute lung injury (TRALI)
 - (2) Delayed-type adverse effects
 - i. Graft-versus host disease (GVHD)
 - ii. Post-transfusion hepatitis
 - iii. Human immunodeficiency virus (HIV) infection
 - iv. Human T lymphotropic virus type I (HTLV-I)
2. Consultation by a medical doctor specialized in transfusion medicine (full-time charge at blood transfusion service)
3. Setting of the hospital system by the hospital transfusion committee

X. Preservation and control of records related to transfusion of blood products

For effective measures to be taken in case of adverse effects such as blood-borne infections, when blood products designated as biological products *1 (blood products and plasma-derived products) are to be used, a special record related to the transfused unit must be prepared and preserved for at least 20 years from the date of transfusion. The facts to be recorded are the name, home address of the recipient, the type, lot number or mark of the transfused unit, and the date of transfusion. (Article 68, item 9 of the law, and Pharmaceutical Affairs Law enforced regulation (1961, the Ministry of Health, Labour and Welfare official announcement No. 1) Clauses 238 and 241) *2

*1) Provided in the Law of Pharmaceutical Affairs, Article 2, clause 10

*2) 15/May/2003, Official announcement No. 0515011, Pharmaceutical and Medical Safety Bureau, Ministry of Health, Labour and Welfare, “The explanation to the recipients of biological products and the recording and preservation of records related to the use of biological products” notification to the President of the Japan Medical Association.

XI. Autologous blood transfusion

Autologous blood transfusion, when performed in a hospital with an established appropriate control system, is the safest type of transfusion, avoiding the adverse effects of allogeneic blood transfusion, and, therefore, its use for elective surgery patients should be actively promoted.

Note: To perform predeposit autologous blood transfusion, refer to the “Manual of collection,

preservation and control of autologous blood for transfusion” (Pharmaceutical and Medical Safety Bureau, Ministry of Health Labour and Welfare of Japan, 2/Dec/1994). However, care should be taken to check the latest (newest) version of the manual, since revisions can be made. Also refer to the “Guideline of autologous blood transfusion, revision proposal” of the Japanese Society of Transfusion Medicine and Cell Therapy and the Japanese Society of Autologous Blood Transfusion joint committee (published in The Japanese Journal of Autologous Blood Transfusion, Vol. 14 (1): 1-19, 2001).

1. Methods of autologous blood transfusion
 - 1) Predeposit autologous transfusion: autologous blood is collected prior to surgery and preserved until use;
 - 2) Hemodilution autologous transfusion: autologous blood is collected at the surgical theater, immediately prior to surgery, and the patient is hemodiluted by infusion of a colloid solution;
 - 3) Intraoperative autologous blood recovery: autologous blood is collected from the surgical field during or after surgery;
2. Informed consent
3. Indications
4. Contraindication
5. Items to be checked during autologous blood collection Median nerve injury
 - 1) Vaso-vagal reaction
 - 2) Hemostasis
6. Selection of the method of autologous blood transfusion and their combinations