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Open Heart Surgery without Homologous Blood Transfusion

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It has been considered that cardiac surgery requires large amounts of homologous blood,¹⁾ however the effects of using homologous blood such as, allergic reaction, homologous blood syndrome²⁾³⁾ and post-transfusion serum hepatitis⁴⁾⁵⁾ have been frequently mentioned as disadvantages of this system. Since 1962, open heart surgery without homologous blood transfusion has been performed in some institutes in Japan⁶⁾⁷⁾⁸⁾ and in the world⁹⁾¹⁰⁾¹¹⁾. We have also performed 10 cases of open heart surgery using this method. This report is concerned with the clinical observation and consideration of this method.

Materials and method:

We performed 10 cases of open heart surgery without homologous blood transfusion between August 1976 and September 1978 (Table 1), accounting for 10% of all cases of open heart surgery performed during this period. These 10 cases consisted of the follow; 3 cases of mitral stenosis, 3 of mitral regurgitation, and one each of ventricular septal defect, ventricular septal defect with pulmonary stenosis, ventricular septal defect with aortic regurgitation and pure pulmonary stenosis. There were nine males and one female. Ages of the patients ranged from 16 to 53 years with an average age of 31 years (Table 2). Body weight ranged from 47.5 to 73.0 kg. These cases also included 3 for valve replacement and 2 for pulmonary hypertension with pulmonary artery pressure more than 85 mmHg.

Table 1. Open heart surgery without Homologous blood transfusion

10 cases	
16 ~ 53 ys.	male 9 female 1
47.5 ~ 73.0 kg av.	59.5 kg
Mitral Stenosis	3
Mitral Regurgitation	3
Ventricular Septal Defect	1
VSD + Aortic Regurgitation	1
VSD + Pulmonary Stenosis	1
Pure Pulmonary Stenosis	1

* MVR 3
 PH PPA > 85 mmHg 2
 Anticoagulant therapy 4
 Ryukyu Univ. Hosp.
 (Aug. '76 ~ Sept. '78)

Four patients underwent anticoagulant therapy during the postoperative course for replaced prosthetic valves or huge left atrial thrombus. Priming of the artificial lung was done without homologous blood using Lactate Ringer's solution or hemacell with an average dilution rate about 25% in each case. All the residual blood in the lung was retransfused to the patient after extracorporeal circulation.

Extracorporeal circulation time ranged from 17 to 150 minutes. The amount of blood loss during and postoperative course ranged from 370 to 960ml with an average of 790ml and transfused was 0 to 800ml. In one case, of a 17 year old boy with pulmonary stenosis, autologous blood was not taken before the operation, therefore, no autoblood transfusion was done. In all cases homologous blood transfusion was not done during the entire course of admission. For comparison, ten cases were divided into two groups.

Group I (5 cases) patients with 400ml of autoblood taken at 14 days and again at 7 days, totaling 800ml prior to the operation.

Group II (5 cases) consisting of one patient with no autoblood taken and four patients with 400ml autoblood taken at 7 to 3 days prior to the operation. Blood cell count, total serum protein, serum albumin, fibrinogen, SGOT (glutamic oxaloacetic transaminase) SGPT (glutamic pyruvic transaminase) and SLDH (lactate dehydrogenase) levels were studied from 14 days prior to and 21 days after the operation.

Table 2. Blood balance

age ys	sex	weight Kg	ECC time min.	loss ml	auto transfusion ml
1.39	m	73.0	150	960	700 (-260)
2.26	f	47.5	117	750	800 (+50)
3.45	m	52.0	80	640	800 (+160)
4.17	m	51.5	64	845	800 (-45)
5.20	m	57.0	90	930	800 (-130)
6.34	m	63.0	80	945	450 (-495)
7.53	m	60.0	70	760	400 (-360)
8.37	m	56.0	50	1010	500 (-510)
9.16	m	58.5	37	790	400 (-390)
10.18	m	61.5	17	370	0 (-370)
30.5		59.7	76	790	(-235)

* Group A : 700~800 ml Autoblood transfused

Group B : 0 ~500 ml Autoblood transfused

RESULTS

Taking 800ml of autoblood within two weeks or 400ml within a week cause no anemia (Fig. 1a, b) in the patients. Blood cell counts were only slightly reduced on the day before the operation in both groups (Fig. 1a, b). Increased platelet count showed the patients' hematopoietic system in a state of hyperactivity (Fig. 2,3). There was no hypoproteinemia or hypoalbuminemia in either group. Average hemoglobin levels were over 10.0 g/dl at any point examined and far over 10.0 g/dl at 3 weeks after the operation (Fig. 1a). Average hematocrit level was over 30% at any point in both groups. Some cases showed low hematocrit levels of less than 30% one or two weeks after the operation, but these patients recovered to over 30% within three weeks (Fig. 1b). Although hemoglobin and hematocrit levels indicated good recovery when examined at 3 weeks after the operation, the elevated platelet and reticulocyte counts suggested the hematopoietic system was still in a hyperactive state (Fig. 2,3). SLDH levels were elevated during the first to seventh day after the operation, and returning to normal levels within 2 weeks after the operation in both groups (Fig. 5). SGOT and SGPT were normal within 2 and 3 weeks after the operation (Fig. 6,7). No cases went over 100 units during the two to three weeks after the operation.

There were no cases of icteric hepatitis in our study.

Change in fibrinogen level showed overshooting at first and third weeks after the operation (Fig. 8). Course of total protein and albumin levels showed no hypoproteinemia or hypoalbuminemia occurred during, before, and the postoperative course (Fig. 4).

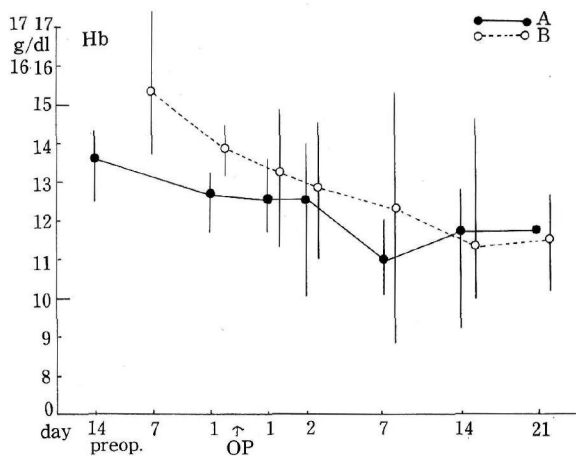


Fig. 1a) course of Hemoglobin

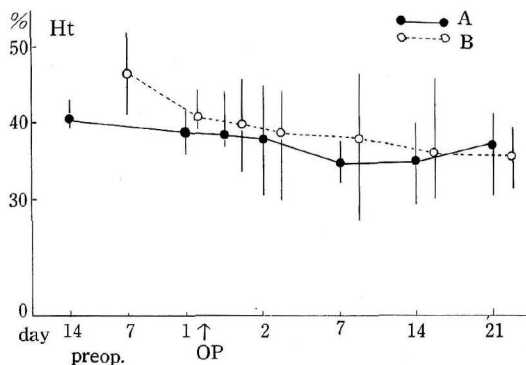


Fig. 1b) course of Hematocrit

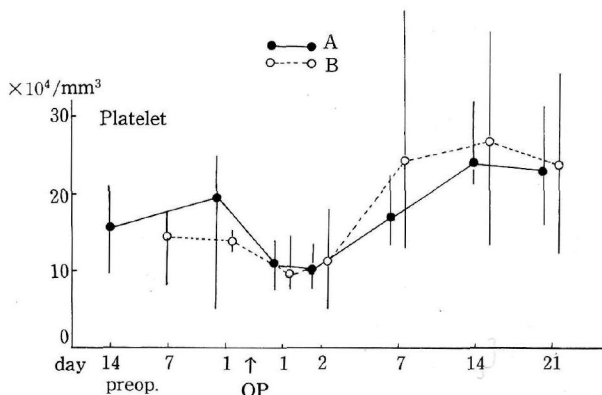


Fig. 2) course of platelet

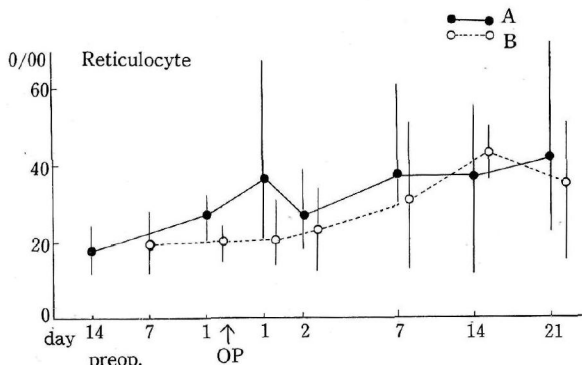


Fig. 3) course of Reticulocyte

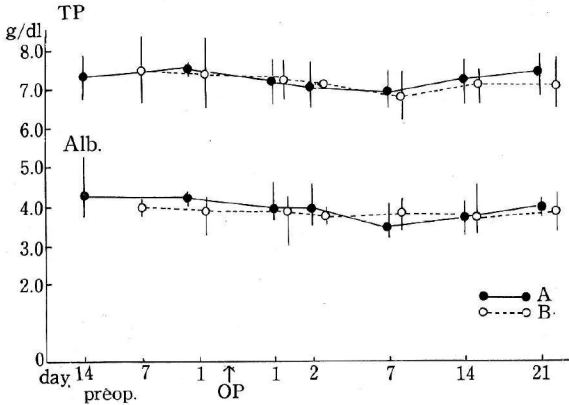


Fig. 4) course of Total protein and Albumin

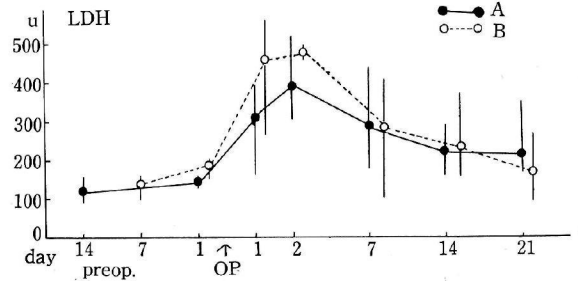


Fig. 5) course of LDH level

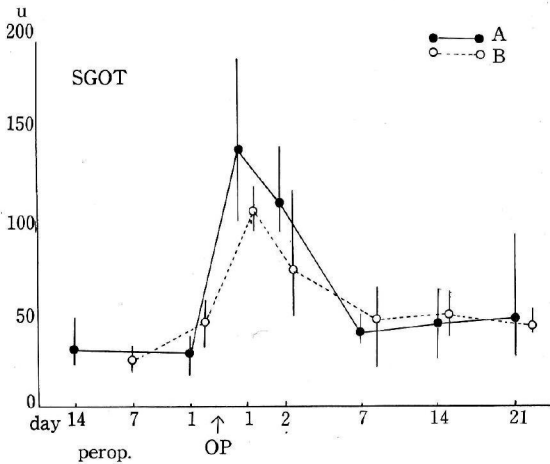


Fig. 6) course of SGOT

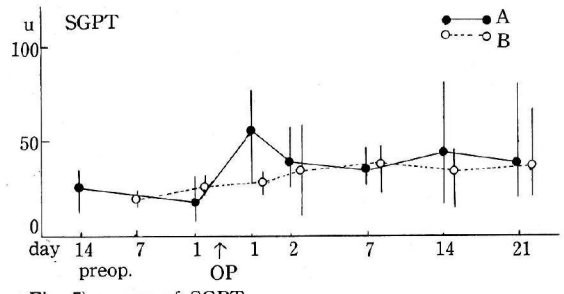


Fig. 7) course of SGPT

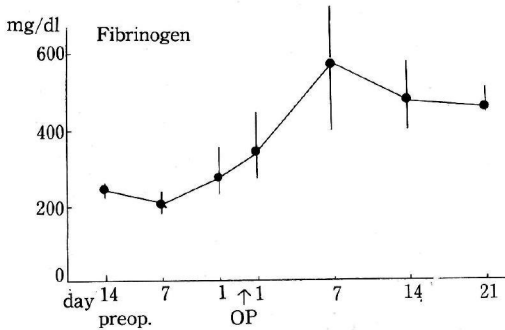


Fig. 8) course of Fibrinogen. 4 cases (3 of group A and 1 of group B)

Discussion

There were many problems associated with blood transfusions, such as homologous blood syndrome, allergic reaction and posttransfusoin hepatitis, furthermore it is often difficult for the patient's family to find donors with compatible blood.

We experienced two cases of icteric hepatitis among the 90 cases who recieved homologous blood transfusion during and after the operation. Therefore, if possible, it is cleary desirable not to use homologous blood in open heart surgery. In 1962, Cooly in Texas, U.S.A had already

performed open heart surgery without homologous blood.

We also performed 10 cases of open heart surgery without homologous blood. All cases made good recovery and hematologic and enzymologic data indicated good recovery of all the parameters studied.

Taking autologous blood caused no anemia or hypoproteinemia before the operation, with all cases returning to normal levels within 3 week after the operation, although the hematopoietic system still appeared in a hyperactive state.

The average amount of blood loss during and after the operation was almost the same as that of transfused autoblood. To replace blood loss with autoblood made it easier to maintain blood pressure at desirable levels than to replace with plasma expander or electrolyte solution, or to use vasopressor. Autoblood transfusion is thought to have an advantage in hemodynamic control of postoperative patient. There were some patients among the other 90 cases who received both autoblood and homologous blood, but the required amount of homologous blood was inevitably reduced.

There is the opinion that blood used in the heart lung machine is damaged during extracorporeal circulation and if all the residual blood in the artificial lung is retransfused, severe hemolysis may occur during the postoperative course. In our cases, the serum LDH level returned to normal within 2 weeks after the operation, so it was considered there was no problem with hemolysis.

SGOT and SGPT levels indicated no side effects of serum hepatitis in cases of autoblood transfusion.

Anemia and hypoproteinemia will cause many problems in the hemodynamic stabilization and host defense capacity against infection during the postoperative course. Therefore, patients with a hemoglobin level under 10.0g/dl or a total protein level under 6.5g/dl should not be subjected to this method.

Long time extracorporeal circulation will damage blood components and cause severe anemia or low proteinemia, therefore, cases that may require 150 minutes or more extracorporeal circulation time for intracardiac repair should also not be subjected to this method.

The patient's body weight is another factor, since excessive hemodilution is not desirable. The patient's body weight should be over 40.0kg considering the priming volume of commercially obtainable artificial lung.

SUMMARY

From the 10 cases of open heart surgery performed without homologous blood transfusion, we studied general limitation and indication of this method. Results are summarized as follows:

1. This method can be performed safely if the candidate is properly selected.
2. Patients with anemia or hypoproteinemia should be excluded.
3. Patients requiring excessive extracorporeal circulation time should also be excluded.
4. Application of this method can be extended to those cases with moderate operative risk such as valve replacement surgery.

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