Study on the Protective Effect of Platelet Autotransfusion in Cardiopulmonary Bypass

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Objective: To study the blood protective effect of platelet autotransfusion in cardiopulmonary bypass. Methods: In this study, 80 patients with cardiopulmonary bypass heart surgery in our hospital from January 2018 to July 2019 were divided into two groups. The control group was not given platelet separation, the study group was given platelet separation after anesthesia induction, platelet rich plasma was extracted before heparinization for cardiopulmonary bypass and heparin was recycled. The blood clotting function, postoperative recovery, blood transfusion volume and postoperative drainage volume were analyzed before operation, 1H, 24h and 48h after operation. Result: Compared with the control group, the volume of blood flow, blood plasma and platelet transfusion in the study group decreased significantly in the first hour after operation, the difference was statistically significant ($P < 0.05$). The recovery of the study group was slightly better than that of the control group, and the difference was not statistically significant ($P > 0.05$). Conclusion: Autotransfusion of platelets can alleviate the coagulation function of patients undergoing cardiopulmonary bypass, reduce the amount of postoperative bleeding and allogeneic blood transfusion, and protect the blood.

Key words: Self platelet separation; Cardiopulmonary bypass; Cardiac surgery; Blood protection
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Most heart operations need to be carried out under the condition of cardiopulmonary bypass. During the operation, the circulating blood should contact with the surface of foreign bodies, activate coagulation factors and platelets, release a large number of bioactive substances, and affect the function of platelets to a certain extent, which is also the key factor of postoperative coagulation dysfunction of patients [1-2]. Some scholars have shown that after 10 minutes of cardiopulmonary bypass, the platelet count will decrease. After protamine neutralizes heparin, the platelet count will show the lowest point, and the time of cardiopulmonary bypass will increase, resulting in platelet damage [3-4]. The purpose of preoperative platelet separation is to prepare platelet rich plasma after anesthesia and in the early stage of cardiopulmonary bypass, so as to protect platelets as much as possible, so as to avoid stimulation and damage during cardiopulmonary bypass. After

cardiopulmonary bypass, protamine is used to neutralize heparin and reinfusion platelets. In such cases, it is beneficial to the recovery of postoperative coagulation dysfunction, improve the hemostasis effect, and then the role of air conduction blood protection, and reduce the amount of blood transfusion [5-6]. In this study, the therapeutic status of patients undergoing cardiopulmonary bypass heart surgery was analyzed and compared, and the protective effect of platelet autotransfusion in cardiopulmonary bypass heart surgery was explored. The results are as follows.

DATA AND METHODS

General information

From January 2018 to July 2019, 80 patients with cardiopulmonary bypass heart surgery in our hospital were divided into two groups. In the control group, there were 30 males and 10 females, the highest age was 73 years, the lowest age was 37 years, the average age was (61.9 ± 10.1) years, the body weight was (67.5 ± 13.5) kg, the body surface area was (1.64 ± 0.15) m2, the cardiopulmonary bypass time was (135 ± 23.5) min, and the aortic occlusion time was (69.5 ± 14.1) min; in the study group, there were 28 males and 12 females, the highest age was 72 years, the lowest was 36 years, and the average age was (59.9 ± 13.5) years. Body weight (68.9 ± 17.1) kg, body surface area (1.63 ± 0.31) m2, cardiopulmonary bypass time (129 ± 29.1) min, aortic occlusion time (63.7 ± 16.1) min. There was no statistical significance in basic information ($P > 0.05$).

Method

In the study group, after anesthesia induced tracheal intubation, a central catheter was placed in the internal jugular vein, after which blood was collected for self-platelet separation, which should be completed before heparinization. In strict accordance with the operation indicators, platelet poor plasma and platelet rich plasma are collected from red blood cells. During the blood collection process, lactate nanoringer solution is used to stabilize the hemodynamics. According to the actual situation of the patient, circulation separation is carried out, and the blood cells separated from the previous circulation are transported back to the patient's body. The platelet rich plasma is preserved by concussion until protamine. After neutralization, heparin was infused back. Venous blood was collected before anesthesia induction, before heparinization and 1h after operation, and retrograde blood routine and coagulation examination were performed to observe prothrombin time and fibrinogen [7].

Observation indicators

The blood coagulation function of the two groups before operation, 1H, 4H and 48h after operation was analyzed, including APTT, Hb, Pt, FIB, etc.; the induced flow and blood transfusion volume after operation were observed; the recovery of the patients after operation was analyzed, including ICU time, secondary thoracotomy, and ventilator assistance time; and Thromboelastography monitoring [8].

Statistical methods

The survey data of this study were analyzed by spp20.0, and the allele and gene frequency were calculated. Haplotypes were constructed by haploview4.0.

RESULTS

Comparison of coagulation function

One hour after operation, the difference of Hb and PLT in the study group was not significant compared with that before operation, and the difference was statistically significant ($P < 0.05$) at 24 hours and 48 hours after operation; the difference of Hb and PLT in the control group at each time period was significant compared with that before operation ($P < 0.05$), and the comparison between the study group and the control group at one hour after operation was higher, as shown in Table 1.

Comparison of postoperative induced flow, blood transfusion rate and blood transfusion volume

Compared with the control group, the induced flow of 1 and 24 hours after operation in the study group was lower, and the infusion volume of

allogeneic red blood cells, plasma and platelets decreased significantly compared with the control group ($P < 0.05$), the difference was statistically significant (see Table 2).

Postoperative recovery

The recovery of the study group was better than that of the control group, but the difference was not statistically significant ($P > 0.05$), as shown in Table 3.

Table 1.
Comparison of coagulation function in control group

Index	Preoperative	Postoperative 1h	Postoperative 24h	Postoperative 48h
Hb/（g·L^{-1}）	138±18	99±10	114±12	119±14
Plt（109·L^{-1}）	177±53	97±31	137±28	140±33
PT/s	12.05±0.6	14.1±1.1	13.5±0.8	13.3±1.1
APTT/s	31.1±2	45.1±9	37.0±5	32.1±4
Fib（g·L^{-1}）	3.5±0.8	2.2±0.8	2.9±0.8	2.8±0.8
Comparison of coagulation function in Study Group				
Index	**Preoperative**	**Postoperative 1h**	**Postoperative 24h**	**Postoperative 48h**
Hb/（g·L^{-1}）	139±18	102±11	117±10	116±12
Plt（109·L^{-1}）	191±46	143±37	146±44	150±32
PT/s	11.9±0.7	13.2±1.6	14.6±0.6	13.8±0.8
APTT/s	33.1±5	42.1±7	38.1±5	33.5±7
Fib（g·L^{-1}）	2.9±0.9	2.3±1.7	2.8±0.9	3.0±1.1

Table 2.
Comparison of postoperative drainage, transfusion rate and transfusion volume

Drainage and allogeneic blood transfusion	Control group (n = 40)	Research Group (n=40)	t/x^2	p
1 hour after drainage (ml)	53±13.5	32±10.7	7.710	0.000
Drainage 24 hours after surgery (ml)	356±67	267±88	5.089	0.000
Allogeneic red blood cell transfusion / U	3.1±0.4	2.0±0.5	10.865	0.000
Allogeneic red blood cell transfusion rate /%	22（55.0）	13（32.5）	10.286	0.001
Allogeneic plasma infusion (ml)	377±163	205±143	5.017	0.000
Allogeneic plasma infusion rate (%)	27（67.5）	15（37.5）	18.045	0.000
Allogeneic platelet transfusion volume (ml)	2.1±1.2	1.3±0.3	4.091	0.000
Allogeneic platelet transfusion rate (%)	6（15.0）	5（12.5）	0.264	0.608

Figure 1.
Platelet activation rate

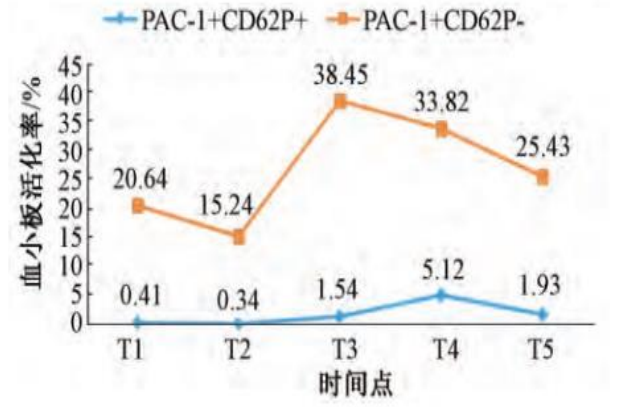

Figure 2.
Platelet activation rate before separation and transfusion

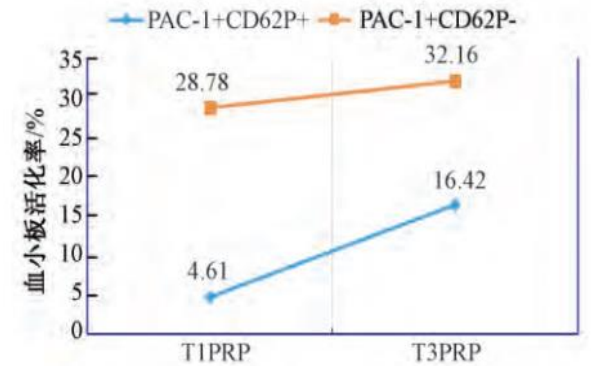

Table 3.
Postoperative recovery

Index	Control Group	Research Group	t	p
Ventilator assist time (d)	26±20.9	24±17.4	0.465	0.643
ICU time (d)	4.6±2.5	4.2±1.4	0.883	0.380

Secondary chest opening (n)	2（5.0）	1（2.5）	0.866	0.352
One-month postoperative mortality rate (%)	0	0	-	-

Index comparison of thromboelastography

The R-value of the study group and the control group at 1h after operation was significantly increased compared with that before operation, and the difference was statistically significant ($P < 0.05$), and the R-value of the control group was superior to that before operation in all time periods, as shown in Table 4.

Table 4.
Comparison of indexes of thromboelastogram in control group

Index	Preoperative	Postoperative 1h	Postoperative 24h	Postoperative 48h
R value (min)	4.8±1.1	8.1±1.3	7.5±1.8	7.1±1.9
K value (min)	2.1±0.5	1.9±0.6	2.3±0.6	2.1±0.8
MA value (min)	63.4±6.5	58.4±7.3	57.3±8.5	56.5±7.1
Angle α	63.3±4.9	58.6±7.2	57.2±8.1	56.2±7.0
CI value	-1.8±0.4	-1.8±0.5	-1.9±0.4	-1.8±0.4
Comparison of indexes of thromboelastography in Study Group				
Index	**Preoperative**	**Postoperative 1h**	**Postoperative 24h**	**Postoperative 48h**
R value (min)	4.7±1.2	6.2±1.0	5.1±2.0	4.9±1.7
K value (min)	2.1±0.2	1.9±0.5	2.1±0.7	2.2±0.8
MA value (min)	66.4±6.5	78.4±5.8	81.1±7.8	79.2±5.5
Angle α	62.4±5.1	58.5±5.4	61.1±7.8	59.1±5.5
CI value	-1.4±0.4	-1.8±0.6	-1.8±0.9	-1.9±0.8

DISCUSSION

Most heart operations need to be carried out under the condition of cardiopulmonary bypass. During cardiopulmonary bypass, the number of platelets will decrease to a certain extent, and their functions will decline, which is also the key factor leading to postoperative coagulation dysfunction and abnormal bleeding. During cardiopulmonary bypass, platelets will contact with artificial materials, so platelets will be activated to form micro thrombus, which will be absorbed on the surface of microcirculation and foreign bodies, and the content of platelets in blood will be naturally reduced. In addition, hypothermia, intracardiac attraction and narcotic drugs will cause the decrease of platelets and abnormal function. Platelet coagulation and hemostasis are affected by adhesion and aggregation of platelets and platelet surface glycoproteins. The membrane glycoproteins on the surface of platelets include CD63, CD61, etc. CD61 can bind to activated platelets and static platelets, which belongs to the specific pan platelet surface marker [9]. When vascular endothelial cells are damaged, platelets will adhere to the affected area, gather, form clots, release corresponding hormones and vasoactive substances, and then form thrombus, which has the effect of hemostasis. And platelets can also participate in inflammation and corresponding immune function. During platelet adhesion, membrane glycoprotein and vWF will play a role. During cardiopulmonary bypass, the molecular number of platelet membrane glycoprotein will be reduced, which will have an impact on platelet adhesion function. GPIIb / IIIa molecular configuration will turn to fibrin binding, and platelet will have the status of transmembrane information transmission, and its function will be blocked, which will affect platelet aggregation. In the process of cardiopulmonary bypass, blood vessels will contract, platelet aggregation and microcirculation will be affected to some extent.

Platelet separation technology is based on the specific gravity difference of blood composition, which is separated by centrifugation, equipped with blood collection pipes and blood collection bags. The clinical application is more popular is the self-blood recovery machine. After general anesthesia, the blood is discharged in the central venous catheter. After the whole blood is centrifuged, the poor platelet plasma, the rich platelet plasma and the concentrated red blood cells will be obtained. According to the data, the proportion of the

isolated platelet needs to be more than 20% of the whole platelet, so it will have effect in clinical application. Because of the special nature of heart surgery patients, it is necessary to observe the circulation of patients. Some studies have shown that the preoperative self-platelet separation can reduce the blood volume of patients undergoing cardiac surgery, and will not affect the cardiac output. After corresponding treatment, it can maintain the hemodynamics of patients, and will not increase the operation time. Platelet is the key factor in the process of coagulation. Some scholars have shown that when the platelet count is less than 50 × 109 / L, spontaneous bleeding will occur. After cardiopulmonary bypass, the platelet count of patients decreased significantly, although it was not less than 50 × 109 / L, but after cardiopulmonary bypass, patients were prone to significant bleeding. When the platelet aggregation function was damaged, the ability of allogeneic blood transfusion platelet aggregation would be significantly reduced. The effectiveness of platelet extraction before operation is of great significance for blood protection. Under cardiopulmonary bypass, the trauma of cardiac surgery is relatively large, the operation time is long, and the amount of blood transfusion is large. At present, the blood source in various regions is tense, and there will be many concurrent symptoms of allogeneic blood transfusion. Transfusion of red blood cells with long storage time will increase the mortality rate and mechanical ventilation time after heart surgery. Therefore, more and more attention has been paid to the study of blood protection. In the early stage of cardiopulmonary bypass, the whole blood was collected and the platelet rich plasma was preserved to avoid the influence of cardiopulmonary bypass on it and to protect the function of platelet to the greatest extent. In addition, there were a lot of coagulation factors in the platelet rich plasma. After cardiopulmonary bypass, heparin is neutralized by protamine, and then transfused back to platelets, which can assist coagulation, have better hemostasis effect, and reduce the amount of allogeneic blood transfusion.

In this study, autogenous whole blood was collected for centrifugation. After cardiopulmonary bypass, protamine was used to neutralize heparin, and platelets and clotting factors were preserved. After operation, the clotting function of patients recovered significantly, and the hemostasis effect was excellent. APRP blood protection was determined by the total amount of platelets. The higher the total amount of isolated platelets, the higher the platelet count in the blood after transfusion. High, it can fully reflect the normal function. In the experiment, 26 ± 5% of the total number of platelets were isolated, which indicated that the platelets of the patients who had been isolated and transfused back had a significant increase, the transfusion of allogeneic blood had a decrease, and the reduction of the induced blood flow was affected by the function of platelets. There was no significant difference between the two groups after operation, and follow-up and observation were needed. Zang Wangfu [10] et al. Separated platelets from patients undergoing cardiac surgery. After comparison, there were significant differences between the PrP group and the aPTT group after operation. The drainage volume of the study group was (40.3 ± 14.8) ml at 1 hour after operation, and that of the control group was (270.7 ± 93.3) ml at 24 hours after operation. The fruit is similar.

CONCLUSION

To sum up, for patients undergoing cardiopulmonary bypass heart surgery, autotransfusion of platelets can protect the blood of patients, reduce the transfusion of allogeneic blood, reduce the amount of postoperative bleeding, and avoid the occurrence of blood transfusion complications, which is worth clinical application.

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