The Bata Analysis of Surgical Changes Based on the Computer Aided Analysis of the end of the Cleaning Autotransfusion Technique

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Abstract. Objective: to explore the application and nursing strategy of flushing transfusion technique in orthopedic surgery by computer aided information analysis. Methods: 63 patients underwent orthopedic surgery with autologous blood collection device were treated with concentrated red blood cells. Preoperative nursing, intraoperative nursing, postoperative observation and follow-up were performed during the treatment. Results: the results of computer-aided data analysis and postoperative observation were as follows: the intraoperative blood transfusion volume of 63 patients was 500-1800 mL, with an average of 650 mL. All patients had no complications such as transfusion reaction, allergy, hemolysis and infection. Postoperative blood routine examination, coagulation function, electrolytes and urine routine were normal, and no patients needed blood transfusion. Conclusion: flushing autotransfusion is safe and effective in orthopedic surgery. Meticulous care is the key to a successful operation.

Keywords: Autotransfusion, Orthopedic Operation, Nursing Strategy, Computer Aided Analysis

1. Introduction
Blood shortage directly affects the operation, and with the increase of the incidence of hepatitis and AIDS, the risk of allogeneic blood transfusion to patients is increasing, which significantly troubles the medical staff. Hence, the optimal way of clinical safety and scientific blood transfusion is autogenous blood transfusion. In recent years, the autologous blood transfusion technology developed successfully is a high-tech integrated with medicine, computer, mechatronics, and polymer [1-2]. It is a technology where the hemorrhage in the surgical field of patients is collected and treated during the operation and trans fused back to the patients after anticoagulation, filtration, separation, washing, and purification. Since January 2011[3-4], our hospital began to use the Jingjing Autogenous Blood Recovery Unit (3000P type) in the major operation of the orthopedic department to collect and treat the hemorrhaging during the operation and then reinfusion[5-6], and provide corresponding nursing before, during and after the auto blood reinfusion operation. Excellent outcome has been achieved, with the summary as follows.
2. Data and Methods

2.1. Clinical data
From January 2011 to December 2013, 63 orthopedic patients were selected, including 43 males and 20 females, aged 37-70. Among them, there were 16 cases of lumbar spinal stenosis, 5 cases of cervical spinal stenosis, 25 cases of femoral fracture, 8 cases of lumbar disc herniation, and 9 cases of femoral head necrosis.

2.2. Methods
According to the ’conditions of patients, different operation approaches were adopted. The blood was recovered and transfused back to the patients during the operation. During blood recovery, anticoagulant (500 ml of biological saline plus 25 000 U of heparin) was injected into the recovered blood in the form of micropump or intravenous drip at 100 ml of recovered blood. The anticoagulant contained in the collected blood was 15 ml. After filtration, the recovered blood was quickly centrifuged and separated according to the specific gravity and washed with normal saline. The plasma, broken blood cells and impurity components were divided into the waste liquid bag, and the pure and concentrated red cells were collected in the blood bag and then transfused back to the patients.

In the evaluation of feasible solution and washing blood transfusion washing blood transfusion, it is based on the same training sample set, which contains each solution vector, and various constraint functions corresponding to the optimization object obtained through the evaluation experiment.

\[
\begin{align*}
S &= \left\{ f_i (x_i, u), \quad m = 1, 2, \ldots, z \\
g_j (x_i, u), \quad j = 1, 2, \ldots, n, \quad i = 1, 2, \ldots, \eta \\
h_k (x_i, u), \quad k = 1, 2, \ldots, n^* \right. \\
\end{align*}
\]

Where \( \eta \) represents the scale of the training sample set. To solve the vector \( x_i \) is combined with the evaluation results based on equation (1) to form the required training sample set:

\[
ST = \left\{ (x_i, f_1 (x_i, u), \ldots, f_z (x_i, u)), g_1 (x_i, u), \ldots, g_n (x_i, u), h_1 (x_i, u), \ldots, h_m (x_i, u) \right\}
\]

Upon update, it is required to combine the new solution and the objective constraint function into the training set according to the form of equation (1), and when evaluating on the basis, whether for washing blood transfusion or for feasible solution, ensure that the evaluation value can be obtained through the training sample set after the similar solution is found.

2.3. Nursing methods
1) Preoperative nursing: (1) Routine nursing. Before operation, the temperature, pulse, respiration, blood pressure and body weight were regularly measured. The mental state and hypertension of patients were observed. The operation was performed after blood pressure was properly regulated. Before the operation, the routine examination, such as blood routine, blood glucose, liver and kidney function, blood coagulation function, etc., should be performed to understand if the patient had any contraindications of autotransfusion. (2) Preoperative visit. The anesthesiologist visited the patients one day before the operation to evaluate whether the patients had any contraindications of autotransfusion to control the indications and contraindications of autotransfusion during the operation, such as those with bone tuberculosis, bone tumor, and bone infection. Autotransfusion of autotransfusion can make tumor cells and infection spread. Hence, autotransfusion is not allowed in those conditions. Whether the patients had hemorrhaging inducing factors was evaluated to understand
the drug use, and to take anticoagulants orally for a long time before the operation. The users should stop using anticoagulants one week before the operation, and then perform a selective operation. ③ Psychological nursing. The purpose, method, and necessity of washing blood transfusion technology were explained to the patients and their families before the operation. The patients and their families were informed that autotransfusion was currently recognized as a clinical and practical treatment approach that could avoid adverse reactions and complications due to allogeneic blood transfusion, promote metabolism and their hematopoiesis function, improve their immunity, and promote wound healing. In this way, the patients could understand and recognize the washing blood transfusion technology, thereby eliminating their tension and anxiety and cooperating with the treatment and nursing better.

2) Intraoperative nursing: ① The principles of aseptic operation are followed. Strictly implement the operation procedures and control the performance by using the Jingjing Autogenous Blood Recovery Unit. Check whether the blood recovery device is within the validity period of use, and strictly keep asepsis when connecting each pipeline system of the autologous blood recovery device. Cooperate with the anesthesiologist to operate safely, check whether the connection of each pipeline is sealed, whether there is air leakage, whether the rapid centrifugal rotation of the blood recovery tank device is normal and replace it in time in case of any abnormality. ② Infections are strictly controlled. Antibiotics were used sufficiently 0.5 h before the operation, and antibiotics were added once for more than 3 h. It is necessary to disinfect the skin strictly, incise the skin, and start to recover the blood, to avoid the bacteremia caused by the pollution of autologous blood. If there is hemorrhaging, suction shall be conducted. Keep the negative pressure suction pipe unobstructed. Regulate the negative pressure at 100-120 mmHg. The suction device shall be aimed at the hemorrhaging point for suction. When there is no hemorrhaging, do not empty suction. Avoid inhaling fat and too much air, which will cause the excessive formation of blood bubbles, change the surface tension of red blood cells, increase the damage of blood cells, and affect the blood recovery rate. The anesthesiologist should cooperate with the anesthesiologist to do a good job of autotransfusion. The recovered autotransfusion should be done in time. Under normal temperature, the treated concentrated blood cells should be completed within 6 h. In principle, they should be transfused back to the patients in time after treatment. It is not suitable to be transfused back after more than 6 h. All the patients in this group completed transfusion during operation. ③ Observation of the blood transfusion process. The orthopedic operation is characterized by severe trauma, long operation time, a large amount of hemorrhaging, fast hemorrhaging speed, and difficulty in hemostasis. The anesthesiologist cooperates with the anesthesiologist to closely observe the vital signs, measure the blood pressure, pulse and breath once every 3-5 min, and observe the changes of blood oxygen saturation, urine volume and color, and central venous pressure. The changes in central venous pressure and urine volume are important indicators reflecting the effective circulating blood volume of the body. Whether the patient has ischemia, anoxia, fever, rash, hematuria is observed. Where abnormalities are observed, timely measures are taken to prevent any accidents.

3. Results
Among the 63 patients in this group, the minimum intraoperative transfusion volume was 500 ml, the maximum transfusion volume was 1800 ml, and the average transfusion volume was 650 ml; there was no transfusion reaction in this group, transfusion of allogeneic blood was not required, and no complications such as allergy, hemolysis, and infection were observed; after the operation, reexamination of blood routine, coagulation function, electrolytic quality, and urine routine results were normal for intraoperative autotransfusion of patients. The data were collected from five different hospitals in Hangzhou. The specific distribution of the number of cases, intraoperative autotransfusion, autotransfusion, and allogeneic transfusion are shown in Table 1 as follows.
Table 1. Intraoperative autotransfusion, autotransfusion and use of allogeneic RBC in medical institutions

| medical institution | Number of cases | Number of cases of intraoperative use of autologous blood recovery (%) | Cases of intraoperative autotransfusion (%) | Effective utilization rate of intraoperative autotransfusion (%) | Number of blood transfusions of RBC variants (%) |
|---------------------|----------------|-------------------------------------------------|-----------------------------------------|-------------------------------------------------|-----------------------------------|
| A                   | 195            | 64.9                                           | 49.2                                    | 70.5                                            | 31.8                              |
| B                   | 170            | 70.7                                           | 52.4                                    | 74.2                                            | 32.3                              |
| C                   | 240            | 70.3                                           | 57.1                                    | 81.5                                            | 33.3                              |
| D                   | 506            | 63.2                                           | 45.7                                    | 74.5                                            | 29.2                              |
| E                   | 220            | 58.6                                           | 48.6                                    | 83.9                                            | 31.3                              |

During and after the operation, there was a high rate of RBC transfusion. For the operation time and hemorrhagic amount during the operation, P < 0.05. See Table 70 A and B for analysis. Currently, there is no significant difference between the two groups in 72h induced flow, 72h plasma, platelet, and hemostatic use rate, and the HB value of 5 d after operation, as shown in Table 2.

Table 2. Comparison of intraoperative and postoperative allogeneic transfusion related factors between the two groups

|                         | A(n=660) | B(n=671) | P       |
|-------------------------|----------|----------|---------|
| Operation time (min)    | 195±90   | 150±75   | 0.000   |
| Blood loss during operation (mL) | 755±724 | 480±487 | 0.000   |
| Intraoperative RBC infusion rate (%) | 25.8     | 6.5      | 0.000   |
| Postoperative RBC transfusion rate (%) | 25.6     | 12.1     | 0.007   |
| Plasma transfusion rate at 72h after operation (%) | 5.3       | 4.9      | 0.338   |
| Platelet transfusion rate at 72h after operation (%) | 2.2       | 11.8     | 0.413   |
| Use rate of hemostatic drugs 72 h after operation (%) | 13.1      | 280±115 | 0.573   |
| 72 h after operation (ML) | 305±110  | 11.3±1.5 | 0.166   |
| HB value at 5 d after operation (g/dl) | 10.8±1.3  | 150±75   | 0.602   |

4. Conclusions
With the clinical application of the washing blood recovery machine, it can timely provide fully compatible blood at room temperature in orthopedic operation, thereby saving massive blood resources and significantly reducing the cost of blood transfusion; avoiding severe allergic reactions due to allogeneic blood transfusion; preventing hepatitis and AIDS caused by allogeneic blood transfusion, lowering the risks of allogeneic blood transfusion to patients, easing medical staff’s tension and confusion about the shortage of blood resources, and the complications such as hemolysis and immunosuppression due to massive blood transfusion. In the washing autologous blood recovery and autotransfusion process, the aseptic operation principle must to strictly followed to avoid the contamination of autologous blood and the bacteremia thus caused. At room temperature, autologous blood after treatment should be transfused back to the patient within 6 h. In the group, all 63 patients received autotransfusion during operation and presented no infection or red blood cell destroy after operation. During the blood recovery, the suction of negative pressure suction should be low, and excessive air should be avoided if possible during the suction of hemorrhaging in the operative field. In the case of intraoperative hemorrhaging in excessive volume and speed, controlled pressure reduction should be applied according to the blood pressure conditions. In this group, the controlled blood pressure reduction was used for one patient.

In the event of an emergency, if blood transfusion is the primary need to save lives and the urgently needed blood source is unavailable, the application value of autotransfusion is far beyond some complications thus induced. With the development of washing blood transfusion technology, washing autologous blood recovery can be applied during and after the operation to alleviate the blood source tension, meet the operation needs, increase the safety of both doctors and patients, and reduce the incidence of medical accidents.
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