

Is Blood Conservation Optimally Utilized?

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Abstract

Blood conservation and the subsequent prevention of transfusion have assumed an increasingly important role in cardiac surgery. The concern is one of preventing transmission of transfusion related diseases and of conserving an extremely valuable resource (1,2). Cardiac surgery with cardiopulmonary bypass has become the most common operation performed, thus attracting much analysis of transfusion practices. It is estimated that of the approximately 250,000 cardiopulmonary bypass procedures done in the United States each year, the majority require transfusion of blood products (3). It has been calculated that the cardiac surgery services throughout the United States use somewhat over 10% of all the blood product resources that are transfused in this country (4,5). Many methods of blood conservation have been described (Table 1), but there still exists a wide variance in blood product utilization for adult patients undergoing cardiopulmonary bypass procedures. A review of the literature reveals average packed red blood cell transfusion rates from 0.3 up to 8 units per patient (4,6-8). If we further add the transfusion of platelets, fresh frozen plasma, and cryoprecipitate, the total donor exposure to the patient goes up substantially more. A varied patient population has been cited as the reason for these discrepancies but it has been demonstrated in similarly matched groups of patients receiving transfusions, that the patterns were based to some extent upon "prevailing practice" rather than on need (9,10).

The purpose of this study was to identify which methods of blood conservation were being practiced in a major metropolitan area within the United States where the risk of transfusion related disease is relatively high. Secondly, to stratify the frequency of use of particular blood conservation methods in order to estimate how often a particular method was utilized and by what percentage of respondents. Finally, to increase the awareness of the options and difficulties associated with current modalities of transfusion practice and blood conservation.

Methodology

The perfusionists from twenty-two (22) of the twenty-seven (27) metropolitan New York and New Jersey area

hospitals performing adult cardiac surgery with cardiopulmonary bypass were telephone surveyed. This survey reflected a time period up to January 1990. This represents a surgical volume of approximately 13,500 during the calendar year 1989. The survey questions addressed methods of blood conservation routinely practiced during three separate time periods, the preoperative, intraoperative, and post-operative intervals. Blood conservation methods during these three time intervals consisted of predeposit donation, prebypass withdrawal (with and without hemodilution), cell centrifugation of salvaged blood, hemoconcentration (with or without ultrafiltration) and reinfusion of subsequent chest drainage. The perfusionists surveyed were questioned as to the frequency of use of the previously mentioned blood conservation methods. They were offered options of never used, rarely used (less than 20%), moderately used (20-60%), and frequently used (greater than 60%). These responses were then tabulated and analyzed to determine the percentage of respondents utilizing a particular modality and the frequency with which the modalities were used.

Results

Of the twenty-seven (27) potential sources of the survey, twenty-two (22) contacts were made (representing 81% of the centers). The following 6 figures represent each of the blood conservation methods which are listed for the three perioperative periods along with the percentage of the respondents and the corresponding frequency of use. During the preoperative time, predeposit donation was the only method utilized (Figure 1). Twenty-seven (27%) percent responded never using this method. Sixty-eight (68%) percent utilized predeposit donation less than 20% for a total of 95% utilizing the predeposit donation techniques less than 20%. Only one group utilized the method in the moderate range (20-60%).

Prebypass withdrawal with or without hemodilution was employed less than 20% of the time by 79% of the respondents (Figure 2). The results were similar for the use of ultrafiltration devices intraoperatively. (Figure 3). The most frequently utilized method of blood conservation was cell centrifugation (Figure 4). This method was utilized during the intraoperative time period and was utilized

with a frequency greater than 60% of the time by 68% of those perfusionists responding. Sixteen percent (16%) rarely employed it. Lastly, during the intraoperative time other methods, which included plasma sequestration and reinfusion of post-bypass pump contents, only isolated use was demonstrated (Figure 5). One respondent for each mentioned noted frequent (greater than 60%) and moderate (20-60%). During the post-operative phase chest drainage recovery was the only method that was utilized by those surveyed (Figure 6). It's utility was mixed in that some groups used it frequently and others hardly at all. Fifty-three percent (53%) used it less than 20% and 47% employed it moderately to frequently.

Discussion

It is apparent from these results that the methods of blood conservation which rely on the withdrawal of the patient's blood prior to or after cardiopulmonary bypass which include predeposit donation, prebypass withdrawal with or without hemodilution, plasma sequestration, and reinfusion of mediastinal drainage are utilized relatively infrequently. The described methods of stratifying respondents with frequency of utilization method enabled us to study and compare the popularity of different blood conservation techniques without losing specificity of any of the mentioned conservation modalities. For example, if the results had been averaged by taking the amount of times a blood conservation technique was utilized divided by the total number of procedures for the group, the reader would be unable to differentiate whether a method was rarely utilized by the entire group or whether it was frequently utilized by a relatively small percentage of the group.

Previous manuscripts have identified the percent reduction of blood bank requirements with individual and combined blood conservation methods. The amounts of reduction in blood usage ranges from approximately 33-70% (11-15). Ultimately the cardiac surgeons, anesthesiologists, cardiologists and perfusionists are responsible for their own patients as well as the patient and their family. Each member of this network must be aware of their responsibilities. These include a knowledge of all of the blood conservation options and the recognition of them as an important part of the surgical technique.

Predeposit donation, (as mentioned above) can significantly decrease blood product utilization. This only works, however, when patients are given sufficient time for donations and when properly screened and willing to make the extra effort of numerous trips to the blood banks for their donations. Perfusionists must be aware of all methods to conserve prime volumes of their pump oxygenator systems. In a recent survey on conservation methods it was shown that priming volumes range from 1,400 ml to 2,500 ml. These differences most probably result in unnecessary transfusion secondary to inadvertent hemodilution. Addi-

tionally, the cardiac teams must re-evaluate their transfusion trigger for bypass and post bypass hematocrits. It has been shown that hematocrits as low as 15% are safely tolerated for most patients on cardiopulmonary bypass (6).

Anesthesiologists and perfusionists should consider the safe and effective options of removing blood prior to cardiopulmonary bypass. Either via pulmonary artery catheter introducer, sideports or from a specially designed phlebotomy catheter. Several reports have demonstrated that by either of these methods up to 20% of the patients' blood volume can be saved for later post-bypass reinfusion, thereby significantly reducing transfusion requirements (11,16). The components which are stored at room temperature are spared the trauma of a cardiopulmonary bypass circuit and the exposure to systemically administered heparin (17). Post-operatively, surgeons must be willing to reinfuse the mediastinal shed blood along with the previously phlebotomized units. The hesitation to use these products appears unfounded as the literature clearly favors the safe and efficacious use of this technique (18-20).

Lack of use of these modalities suggests a nonoptimal appreciation of valuable blood conservation techniques in this described geographic region. Increased attention to safe, effective and widely available blood conservation techniques is warranted. Further study is needed to evaluate the reasons for these patterns and thereby hopefully, to improve patient care.

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Questions and Comments

Bob Longenicker, St. Louis, Mo.

- Q. Do you have any data currently or are you collecting data that would suggest how effective these methods are in your area of the country, in terms of decreasing your dependence on homologous blood? What percentages of the patients in this survey are actually getting transfused?
- A. Well, it's an interesting question, Bob. Primarily, what we looked for at first was just from the infor-

mation in the literature stating how various techniques have decreased blood usage. We wanted to see how often these techniques were used, so for our own information we did this survey to see what methods were popular in the region, but I think that would be a good idea for a further study.

- Q. Now that patients are being more informed about being able to donate blood and the use of autotransfusion and all these other things, do you think that it is going to aid their decision on what they want done as compared to what is being done?
- A. Primarily, with pre-donation being used more frequently, one of the problems is that by the time the surgeons see these patients, even if they are elective, usually a week prior to surgery. Only one unit of blood can be collected and that is shown not an optimal amount of collection. I feel the cardiologists need to inform these patients about blood conservation because they usually see them weeks before. There is increased awareness and this legally affects surgeons who are required to mention all the techniques that are available to these patients.

TABLE I

- Predeposit Donation
- Intraoperative Withdrawal
- Hemofiltration
- Cell Centrifugation
- Plasma Sequestration
- Chest Drainage Recovery

