PREDICTING THE USE OF BLOOD TRANSFUSION

Robert W. Beart Dr. *

*University of Southern California, rbeart@usc.edu

Copyright ©2009 The Berkeley Electronic Press. All rights reserved.
ABSTRACT Background and Purpose Blood transfusion is associated with post-transfusion reactions, disease transmission and immunosuppression. Little is known about the incidence of blood transfusion in patients undergoing elective colon or rectal resection. The purpose of the present study is to identify the incidence of blood transfusion and factors that predict risks of blood transfusion in patients undergoing colon and rectal resection.

Methods Hospital charts of 206 patients at three hospitals in the Los Angeles area from January 1995 to September 1998 were retrospectively reviewed. Demographic and clinical variables such as age, gender, comorbidities, diagnosis, disease location and operative procedure were recorded.

Results The overall transfusion rate was 48%. The factors that exhibit a positive association with blood transfusion include a low pre-operative hemoglobin level (p-value = 0.000002), disease location in the rectum (RR = 1.37 – 2.44), diagnosis of cancer (RR = 1.10 – 2.07), diabetes mellitus (RR = 1.07 – 2.12), history of cerebral vascular accident (RR = 1.86 – 2.51), and documented coronary artery disease (RR = 1.01 – 2.09).

Conclusion Factors predicting the need for blood transfusion in surgical patients are useful because they may allow implementation of preventative therapy to treat anemia and other conditions. The present study demonstrates a number of pre-operative clinical factors that are predictive of blood transfusion.

KEYWORDS: colon surgery, blood loss, bleeding, transfusion
PREDICTING THE USE OF BLOOD TRANSFUSION
DURING RESECTION OF THE COLON OR RECTUM

Patricia W. Lee, M.D.
Robert W. Beart, Jr., M.D.

at
The Keck School of Medicine
of the
The University of Southern California
Division of Colorectal Surgery

Address Correspondence to:
Robert W. Beart, Jr., M.D.
1450 San Pablo Street, Suite 5400
Los Angeles, California 90033
tel: 323-442-5751 • fax: 323-442-5756
e-mail: rbeart@hsc.usc.edu
ABSTRACT

Background and Purpose
Blood transfusion is associated with post-transfusion reactions, disease transmission and immunosuppression. Little is known about the incidence of blood transfusion in patients undergoing elective colon or rectal resection. The purpose of the present study is to identify the incidence of blood transfusion and factors that predict risks of blood transfusion in patients undergoing colon and rectal resection.

Methods
Hospital charts of 206 patients at three hospitals in the Los Angeles area from January 1995 to September 1998 were retrospectively reviewed. Demographic and clinical variables such as age, gender, comorbidities, diagnosis, disease location and operative procedure were recorded.

Results
The overall transfusion rate was 48%. The factors that exhibit a positive association with blood transfusion include a low pre-operative hemoglobin level (p-value = 0.000002), disease location in the rectum (RR = 1.37 – 2.44), diagnosis of cancer (RR = 1.10 – 2.07), diabetes mellitus (RR = 1.07 – 2.12), history of cerebral vascular accident (RR = 1.86 – 2.51), and documented coronary artery disease (RR = 1.01 – 2.09).

Conclusion
Factors predicting the need for blood transfusion in surgical patients are useful because they may allow implementation of preventative therapy to treat anemia and other conditions. The present study demonstrates a number of pre-operative clinical factors that are predictive of blood transfusion.
INTRODUCTION

Although there have been many improvements in the safety of the transfusable blood supply, transfusion is still associated with risks. Blood transfusions have an immunosuppressive effect and may lead to higher cancer recurrence rates.\textsuperscript{1,2,3,4} Post-transfusion reactions, blood-borne infections and disease transmission are of concern.\textsuperscript{2,5,6,7} In the present study, we attempt to identify factors that can predict the need for blood transfusions in patients going through elective colon or rectal resection. Identification of such predicting factors may allow timely implementation of appropriate alternative therapy in these high-risk patients.
METHODS

The study protocol was approved by the Institutional Review Board at the University of Southern California, Keck School of Medicine (Proposal #98A059, Review Category E). All surgical procedures were performed between January, 1995 and September, 1998. Patients who had an open, transabdominal colon or rectal resection at the Los Angeles County Medical Center, Norris Cancer Hospital, and the University of Southern California University Hospital were retrospectively studied. These hospitals were chosen because they are affiliated with the same teaching program and all cases were supervised by one of three staff surgeons operating at each of the hospitals. Demographic and clinical variables were recorded by review of the medical records. Table 1 contains the categories of data collected.

For statistical support, we used Epi Info Version 6. In our analysis, we relied on the Greenland 95% confidence interval for relative risks, ANOVA for analyzing normally distributed data, and Kruskal-Wallis One Way Analysis of Variance for data that are not normally distributed.
RESULTS

Between January 1995 and September 1998 at these three institutions, a total of 531 patients underwent elective colon or rectal resection. Of those, 206 charts were available at the time of this study for review. The age range was 11 to 87, with the mean age at 56 and the median age at 57. There were 127 men and 79 women. Table 2 contains the results of the co-morbidities examined. Altogether, there were 119 cases of colorectal cancer, 16 cases of polyps, 46 of inflammation, and 25 with miscellaneous diagnoses such as prolapse or fibrosis. Of those patients with cancer, 22 had stage I disease, 46 stage II, 29 stage III, and 22 stage IV. Regardless of diagnosis, the disease was located in the right colon in 25 patients, transverse colon in 11, left colon in 8, sigmoid in 38, rectum in 83, and multiple areas in 41. Of those with multiple area involvement, 4 included the rectum. The procedure performed was segmental resection in 158 cases, total colectomy in 18, proctocolectomy in 20, and abdominoperineal resection in 10 cases. The range of estimated blood loss was from 50 to 10,000 ml., with a mean of 768 ml. and a median of 400 ml. The range of pre-operative hemoglobin was 4.7 to 17.4, with a mean of 12.4 and a median of 12.9. In this study, 98 patients (48%) received blood transfusions during their hospital stay, with a total of 482 units of blood transfused. Of these, 30 were given pre-operatively, 252 intra-operatively, and 200 post-operatively. The post-operative complications are listed in Table 3.
DISCUSSION

The safety of allogenic blood transfusion is a concern to patients and physicians. Transfusion reactions, including post-transfusion purpura, acute lung injury and anaphylaxis, although rare, are devastating to the patients when they do occur. The incidence of viral transmission from our current blood supply has decreased due to the stricter measures of screening and testing. The transmission rate is 1/675,000 for human immunodeficiency virus, 1/63,000 for Hepatitis B, and 1/100,000 for Hepatitis C. In spite of these optimistic numbers, there are always concerns for other blood-borne pathogens of which we know little and for which we have no reliable tests (Trypanosoma cruzi and Creutzfeld-Jakob disease.) In addition, there have been studies documenting the immunosuppressive effect associated with blood transfusion. It remains controversial whether transfusion increases the risk of recurrence after curative resection of colorectal cancer. Because of these multiple potential problems, most physicians will minimize the use of blood products. Retrospectively, indications for transfusion were impossible to determine but likely similar amongst these three staff surgeons. More rigorous indications for transfusion may have altered the incidence of transfusion.

Of the 531 patients identified, only 206 were reviewed. This is due to lack of medical record availability at one of our hospitals but was not thought to be a systematic error in this study. There are a number of ways to avoid blood transfusion in surgical patients. First, surgical techniques and approach can be refined to emphasize less bleeding.
during surgery. Variations in surgical technique were minimal in this study since all three staff surgeons trained and work together. Different surgical techniques, however, may have decreased the blood loss and incidence of transfusion. These include gentler handling of tissues, vascular isolation and temporary occlusion, electrocautery and laser techniques. Furthermore, intra-operative red cell recovery devices can be used to salvage the patient's blood. A number of hemostatic agents have also been demonstrated to stop bleeding in surgical patients. To avoid using allogenic blood products, many patients have chosen to donate autologous blood. Despite its popularity, this method is only feasible in patients who are not anemic. In anemic patients, marrow stimulation with recumbent erythropoirtin holds promising potential in colorectal patients. However, the use of erythropoietin is only effective in those with sufficient iron store and functioning marrow. With the availability of so many possible alternatives to blood transfusion, each with its own advantages and disadvantages, the prediction of patients at risk for blood transfusion could be useful because proper therapy can be appropriately implemented.

The present study attempts to identify predicting factors for blood transfusion in patients scheduled for elective colon or rectal resection. The number of cases in this series does not allow for subgroup analysis by extent of disease such as: the presence or absence of an abscess with diverticular disease, the extent of adjacent organ involvement with Crohn’s disease, previous intraabdominal surgery, or preoperative radiation. Therefore we did not assess individual risk factors for outcome by univariate analysis. The pre-operative hemoglobin level is found to have a linear relationship with
the need for transfusion. As the pre-operative hemoglobin level increases, the percentage of patients transfused decreases. The mean pre-operative hemoglobin levels for transfused patients was 11.5, and for non-transfused patients was 13.2 (p-value = 0.000002). The average number of transfusions per person within each hemoglobin level is also statistically significant, p-value = 0.000023.

The location of the disease is an additional predictor for transfusion (Chi Square = 23.80; p-value = 0.0002). Involvement of the rectum is positively associated with blood transfusion with a relative risk of 1.82 (1.37 – 2.44), when compared to those involving the colon only. It is an independent risk factor for blood transfusion not related to pre-operative hemoglobin. In fact, the present study indicates that the pre-operative hemoglobin levels in patients with and without rectal involvement are equivalent (12.5 and 12.3 respectively). The mean estimated blood loss is 1,223 cc for patients with disease in the rectum, compared to 435 for those without (p-value < 0.000001).

The disease diagnosis is another predictor (Chi Square = 9.26; p-value = 0.026). Cancer carries a relative risk of 1.51 for blood transfusion (1.10 – 2.07), when compared with all the other diagnoses combined. Cancer patients have a lower pre-operative hemoglobin than non-cancer patients (12.1 vs 12.7; p-value = 0.045). Of the co-morbidities examined, a positive history of diabetes mellitus (RR = 1.51; 95% interval 1.07 – 2.12), cerebral vascular accident (RR = 2.16; 95% interval 1.86 – 2.51) and coronary artery disease (RR = 1.46; 95% interval 1.01 – 2.09) are all positive predictors of blood transfusions. Of these, a history of cerebral vascular accident is related to the pre-operative hemoglobin level. In those with positive history, the mean hemoglobin...
level is 10.5; in those without, it is 12.4 (p-value – 0.046). Diabetes mellitus and coronary artery disease, on the other hand, are independent risk factors. However, we must exercise caution when interpreting these results. It is important to keep in mind that the number of patients with these co-morbidities are quite small, and that any observations in small samples of patients may lack sufficient power to be extrapolated to the population at large.

Variations in factors such as gender, age, stage of disease, were not statistically significant. In the present study, the only post-operative complication found to be associated with blood transfusion was post-operative bleeding. Such an association most likely exists because in patients who are bleeding from an obvious source, blood transfusions are often necessary. In fact, all of these who had bleeding complications received blood transfusions.

CONCLUSIONS

Predicting factors for blood transfusion in surgical patients are useful because they allow surgeons to implement appropriate therapy, whether it be autologous blood donation, pre-operative marrow stimulation, or a different surgical approach. The present study found specific positive predictors for blood transfusion in patients undergoing elective colon or rectal resection.
REFERENCES


Table 1

Demographic and Clinical Variables

Age
Gender
Co-morbidities
Diagnosis
Stage of Disease
Location of disease
Operation
Estimated Blood Loss
Hemoglobin trend
Transfusion History
In-House Complications
Table 2

<table>
<thead>
<tr>
<th>Co-Morbidities</th>
<th># of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension</td>
<td>41</td>
</tr>
<tr>
<td>Coronary Artery Disease</td>
<td>18</td>
</tr>
<tr>
<td>Diabetes Mellitus</td>
<td>19</td>
</tr>
<tr>
<td>Arthritis</td>
<td>18</td>
</tr>
<tr>
<td>Cerebral Vascular Accident</td>
<td>5</td>
</tr>
<tr>
<td>Liver Disease</td>
<td>3</td>
</tr>
<tr>
<td>Cancer (Not colon or Rectum)</td>
<td>15</td>
</tr>
<tr>
<td>Prior Abdominal Surgical History</td>
<td>101</td>
</tr>
<tr>
<td>Tobacco Use</td>
<td>60</td>
</tr>
<tr>
<td>Alcohol Use</td>
<td>85</td>
</tr>
<tr>
<td>Intravenous Drug Use</td>
<td>3</td>
</tr>
<tr>
<td>In-House Complications</td>
<td># of Patients</td>
</tr>
<tr>
<td>---------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>Wound Dehiscence</td>
<td>0</td>
</tr>
<tr>
<td>Wound Infection</td>
<td>7</td>
</tr>
<tr>
<td>Urinary Tract Infection</td>
<td>8</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>7</td>
</tr>
<tr>
<td>Anastomotic leak</td>
<td>4</td>
</tr>
<tr>
<td>Thrombotic Event</td>
<td>3</td>
</tr>
<tr>
<td>Congestive Heart Failure</td>
<td>2</td>
</tr>
<tr>
<td>Bleeding</td>
<td>10</td>
</tr>
</tbody>
</table>