Crossing Over of Autologous and Directed Donor Blood*

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ABSTRACT

There is a considerable interest in the possibility of crossing over autologous and directed donor blood to other patients. The practicality and safety of this approach depends on the possibility of disease transmission in these groups versus those of the usual homologous donors. A review of the current literature as to the incidence of infectious disease markers shows that the total number of donors studied is rather small, and the results are not too clear. Some studies maintain crossing over is strictly unacceptable; others feel it is safe. The safest approach at this time is to repeat the studies in one's own laboratory and derive the risks and statistics in the local population.

Introduction

Today, as for many years, there is an undersupply of blood for transfusion. For this reason, many different approaches to increasing the donor pool are being tried. These include expanding the acceptable age limit of donors, redefined exclusion criteria and establishing better recruiting methods. In the meantime, the various required tests of the blood have each taken their toll in removing a certain number of donors from the pool. Certainly, these tests have made blood transfusion much safer, but they have also limited the number of donors available. Thus, some donors have been lost while others have been gained.

With the advent of the acquired immune deficiency syndrome (AIDS) epidemic, an unreasonable fear of using homologous blood and blood products has arisen, and many more patients have begun to ask either for their own blood to be stored for possible autologous transfusion or to be allowed to provide designated donors (i.e., donors known to them). The work of Milles et al showed that autologous blood could be used in surgery and created some interest in such donations. However, at the time these studies were done, the anticoagulants had such a short effective span that long term storage of autologous blood was not too practical. It is self-evident that if errors of labelling, processing, or storage can be eliminated, the safest blood for any patient is his/her own. Therefore, there should be great interest in encouraging autologous blood donations. How-

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ever, much of this blood is not transfused. Popovsky\textsuperscript{24} states that “between 25 and 40 percent of autologous collections are not used for the intended recipient.” Thus, this unused blood could represent a new source of blood, if the donor has been subjected to the same history and physical as other donors, and the blood tested similarly to homologous blood for the presence of disease markers.

Anderson and Tomasulo\textsuperscript{3} state that in a questionnaire of 509 institutional members of the American Association of Blood Banks (AABB) 65 percent of the respondents allowed crossing over of autologous units to homologous. However, there are questions raised as to the safety of this blood for transfusion to another patient. Could the donor-patient be of a high risk group? Was the donor’s original disease one that would render the unit of blood unacceptable? Also, what of the directed donor—the one who gives for a specific patient? In this case, the donor, if a multiple donor, could be of the safest group of homologous donors, or if the donor has engaged in high-risk behavior not known to the patient, could be very dangerous. It is difficult to quantitate the amount of pressure exerted on each directed donor by the patient, just as it is very difficult to quantitate the pressure exerted on homologous donors by their peers, shop stewards or superiors. A recent abstract\textsuperscript{21} has even proposed that owing to this pressure, directed donors should not be categorized as volunteer.

While there is some argument as to the safety of these donors, some states have written laws stating that if a patient wants designated donors, the hospital or other service must provide the service to bleed them. This ruling has caused many hospitals to set up some kind of donor program where there never was one before or to make complex and possibly error-prone arrangements with the local blood donor center, or a commercial source, to have them bled. The drawing of these units represents a financial burden to the hospital that must be offset in some manner. If either autologous or directed donor blood is not used by the patient, these units could be “crossed over” and used for other patients. This is dependent on the safety of the donors. The answer to this question of safety is difficult to obtain owing to the small amount of literature available. Although a large number of editorials and opinions have been published, a total of 15 papers have contained hard data. Of these, one is a state bureau report, two are Letters to the Editor, three are Rapid Communications, seven are abstracts that have never been reported in their entirety, one is a Brief Report, and one is a peer-reviewed paper.

**Directed Donors**

The results of testing directed donors are summarized in table I. The earliest report on the safety of blood from directed donors was that of the Washington State Department of Social and Health Services.\textsuperscript{30} It is based on the donor collection statistics of seven blood collection centers in Washington State from May 1985 to August 1986. Two of these centers encouraged directed donation while the rest discouraged or did not particularly encourage them. In this study, only Hepatitis B Surface Antigen (HBsAg) and antibody to human immune deficiency virus (anti-HIV) were recorded. It is hard to review this document critically since very little information about the donors or the methodology of testing is included. Nevertheless, the study reports on 12,641 designated donors and compares them with 675,305 homologous donors.

The report finds the risk factor of HBsAg in directed donors was 2.7 times that of a control group of homologous donors and states that this is statistically significant. This risk factor is derived by dividing the incidence of a disease
marker in one population with the incidence in another. The risk factor for anti-HIV in directed donors is stated to be not statistically significant. The specific tests used, the cutoff points and the number of first time donors in the pool are not given. The final conclusion is that "it is not advisable for the Washington State legislature to mandate the availability of directed donor programs to safeguard the public's safety."

Cordell et al. in a Rapid Communication report their study of 3,063 designated donors. Although the title of the paper is "Experience with 11,916 Designated Donors" and covers a time span for that many donors being drawn, only 3,063 donors, randomly selected, were compared to a comparable group of 3,201 homologous donors and 3,439 first time donors. A significant number of designated donors (70.7 percent) were first time donors, as compared to 20.0 percent of homologous donors. The authors state that no differences were demonstrated between the homologous and directed donors when studied for serological tests for syphilis (VDRL), HBsAg, antibody for Hepatitis B core (HBcAb), and anti-HIV. Their conclusion is that designated donors were no safer, but no less safe than donations that were not designated.

Subsequently, Collins, Baudin, and Cooper reported in an abstract a study of 163 designated donors compared with 5,143 homologous donors. They measured anti-HIV, Alanine aminotransferase (ALT) and HBcAb. They found that 5.1 percent of the homologous units needed to be discarded owing to a positive test for one or more of the markers, as compared with 8.6 percent for the designated donor bloods. This difference was found to be statistically different (p <

### Table I

<table>
<thead>
<tr>
<th>Reference</th>
<th>Number Directed Donors</th>
<th>Number Homologous Donors</th>
<th>Directed Analytes With Change</th>
<th>Analytes Without Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>WA State Dept. Social and Health Services: Review of Advisability of Instituting Directed Blood Donor Programs in WA State. March 1987, pp. 1-17.</td>
<td>12,641</td>
<td>675,305</td>
<td>HBsAg (2.7X)</td>
<td>HIV</td>
</tr>
<tr>
<td>Cordell, Valon, et al: Transfusion 26:484-486, 1986.</td>
<td>3,063</td>
<td>3,201</td>
<td>0</td>
<td>HBsAg, HBcAb, HIV</td>
</tr>
<tr>
<td>Collins, Baudin, &amp; Cooper: Transfusion 27:575, 1987.</td>
<td>163</td>
<td>5,143</td>
<td>1 or more</td>
<td>HBcAb, ALT</td>
</tr>
<tr>
<td>Toy, Hoag, et al: Transfusion 28:175, 1988.</td>
<td>2,170</td>
<td>150,798</td>
<td>ALT (1.9X)</td>
<td>HBcAb (1.38X)</td>
</tr>
<tr>
<td>Starkey, MacPherson, et al: JAMA 262:3452-3454, 1989.</td>
<td>10,090</td>
<td>444,637</td>
<td>HBcAb (1.5X)</td>
<td>HCV, ALT</td>
</tr>
<tr>
<td>Grindon: Transfusion 31:872-873, 1991.</td>
<td>2,462</td>
<td>113,272</td>
<td>0</td>
<td>HBcAb, HBsAg, HIV</td>
</tr>
<tr>
<td></td>
<td>30,589</td>
<td>1,392,356</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ALT = Alanine aminotransferase
HBsAg = Hepatitis B surface antigen
HIV = Human immunodeficiency virus
STS = Serological test for syphilis
HBcAb = Hepatitis B core
HD = Homologous donors
HCV = Anti-hepatitis C
0.05), but the percentage of rejection for each marker is not stated.

An abstract by Toy et al.\textsuperscript{28} reports the results obtained at three different donor centers when the donors were studied with HBsAg, anti-HIV (confirmed with Western Blot [WB]), ALT, and HBCab. This study compared a total of 2,170 designated donors with 150,798 homologous. The HBSAb and HIV tests were not significantly different, but HBCab and ALT rates were higher (1.38× and 1.88×, respectively) in designated donors. Thus, the authors feel that "designated donor units may be less safe than regular homologous units."

In a rather large report performed by 20 blood center members of the Council of Community Blood Banks and published as a Brief Report, Starkey et al.\textsuperscript{27} used data "gathered during a 3-month period [sic] between September 1987 and March 1988" that studied the reactivity of autologous, directed and homologous donors. The following markers were studied: HBsAg, HBCab, HIV, ALT and a serologic test for syphilis (STS) [rapid plasma reagent (RPR)] test. Seventeen of the centers separated the directed donors into first time and repeat donors and in these groups, first time homologous and directed donors were separated for comparison purposes. First time directed donors represented 58.9 percent of the directed donor pool while only 19.7 percent of the homologous donors were giving for the first time. A total of 10,090 directed donors was compared to 444,637 homologous. The percent of donors positive for a marker was determined by comparison with the total group of homologous donors. The risk factor for HBsAg of 2.8× as much as a donor from the total pool of homologous donors. When first time donors of each group were compared, the ratio was 1.7×; however, the raw number of positive directed donors was only 10 out of a total of 10,090. The risk factor for HBCab was found to be 1.5× when all directed donors when compared with all homologous donors. There were no significant differences in ALT results. No anti-HIV positive donors were found in the directed donor pool while the HIV positivity of the homologous donors was 0.01 percent. The authors calculated that the possibility of no anti-HIV positives in the directed donor group could occur 37 percent of the time if the reaction rate were the same as that in homologous donors.

Grindon,\textsuperscript{11} in a Letter to the Editor, reviews 2,462 directed donors and compares them with 113,272 homologous donors. He studied HBCab, HBsAg, HIV and ALT. In this report, Grindon included the incidence of anti-Hepatitis C (HCV). His work showed that even though the directed donor group had twice the number of first time donors there was no significant difference in the markers studied. He also mentioned that the marker frequencies in directed and homologous donors will vary from one region or another.

**Autologous Donors**

The study of autologous donors becomes more complex. In this case, the donor is a patient with some underlying condition that may require transfusion. Therefore, one should not expect the incidence of disease markers to be the same as a volunteer homologous donor who has been screened by history for the presence of disease prior to phlebotomy. Further, a significant number of the donors will not be able to satisfy the donor history requirements or the hematocrit and thus will be excluded from being used for homologous transfusion. For this reason, most reports on autologous donors divide the donors into two groups: one that is acceptable as a
homologous donor by history and hematocrit, and one who is unacceptable for crossing over.

In table II is shown a summary of the reports pertaining to autologous donors. In an abstract presented in 1987, Nicely et al\textsuperscript{20} reported their study of 1,411 units of blood from autologous donors and compared their marker frequencies with those of 700,000 homologous donor units. Markers studied were HBsAg, HIV, ALT, HBCab, and STS (type unknown). In this study, there was a significant increase in the number of autologous donors with elevated ALT and HBCab markers. From these data, the authors feel that the use of autologous donors is "not suitable for homologous transfusion." Conversely, the abstract of Pepkowitz et al\textsuperscript{22} compared the incidence of infectious disease markers found in 4,690 homologous and 142 frozen autologous blood units. Positive markers found were ALT, HBcAb, and a serologic test for syphilis. When compared with the homologous donors, there was no statistically significant differences between the two groups using chi square analysis. The authors feel that "the community would best be served if we continue to utilize components from autologous donations to augment community blood resources."

Popovsky et al\textsuperscript{23} studied 1,965 autologous donors and compared them with 300,000 homologous donors. Some of these donors were drawn in a central

TABLE II
Summary of Reports Pertaining to Autologous Donors

<table>
<thead>
<tr>
<th>Reference</th>
<th>Number Autologous Donors</th>
<th>Number Homologous Donors</th>
<th>Autologous Analytes With Change</th>
<th>Analytes Without Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nicely, Lugo, et al:</td>
<td>1,411</td>
<td>700,000</td>
<td>HbcAb (2.4X)</td>
<td>HIV, HBsAg, STS</td>
</tr>
<tr>
<td>Transfusion 27:517, 1987.</td>
<td></td>
<td></td>
<td>ALT (1.14X)</td>
<td></td>
</tr>
<tr>
<td>Pepkowitz, Fisher, et al:</td>
<td>142</td>
<td>4,690</td>
<td>0</td>
<td>ALT, HBcAb, HBsAg, HIV</td>
</tr>
<tr>
<td>Popovsky, Kruskall, et al:</td>
<td>1,965</td>
<td>300,416</td>
<td>0</td>
<td>HBsAg, ALT</td>
</tr>
<tr>
<td>Shah, Gnutik, &amp; Molstad:</td>
<td>588</td>
<td>1,282</td>
<td>0</td>
<td>HBsAg, ALT, HIV</td>
</tr>
<tr>
<td>Grossman, Stewart, &amp; Grindon:</td>
<td>413</td>
<td>413</td>
<td>HbcAb (3.2X)</td>
<td>HBsAg, ALT, HIV</td>
</tr>
<tr>
<td>Kruskall, Popovsky, et al:</td>
<td>2,211</td>
<td>300,120</td>
<td>STS-BFP (1.5X)</td>
<td>HIV, HBsAg, ALT, HBcAb</td>
</tr>
<tr>
<td>Toy, Hoag, et al:</td>
<td>2,275</td>
<td>150,798</td>
<td>HbcAb (2.8X)*</td>
<td>HIV, HBsAg</td>
</tr>
<tr>
<td>Transfusion 28:345, 1988.</td>
<td></td>
<td></td>
<td>ALT (1.5X)*</td>
<td></td>
</tr>
<tr>
<td>Starkey, MacPherson, et al:</td>
<td>11,940</td>
<td>444,637</td>
<td>HbcAb (2.5X)</td>
<td>HIV, ALT</td>
</tr>
<tr>
<td>JAMA 262:3452-3454, 1989.</td>
<td></td>
<td></td>
<td>STS (3.5X)</td>
<td></td>
</tr>
<tr>
<td>Mazzei, Imberciadori, et al:</td>
<td>250</td>
<td>350</td>
<td>HBcAb (1.8X)</td>
<td>HBsAg, STS, ALT, HIV</td>
</tr>
<tr>
<td>Conover, Fang, et al:</td>
<td>1,476</td>
<td>76,815</td>
<td>0</td>
<td>HBcAb</td>
</tr>
<tr>
<td>Transfusion 31:616-619, 1991</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>22,671</td>
<td>1,989,521</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*In one of the three centers; no change in the other two.
HBsAg = Hepatitis B surface antigen
HIV = Human immunodeficiency virus
STS = Serological test for syphilis
ALT = Alanine aminotransferase
HBCab = Hepatitis B core
HCV = Anti-hepatitis C
BFP = Biological false positive
blood center and some in a hospital. Markers studied were HIV (with WB), HBsAg, ALT and HBcAb. Their conclusion is that "the data ... offer no evidence that autologous blood is less safe than homologous." Shah et al\(^{25}\) studied 588 donor-patients who pre-deposited autologous units and compared them with blood from 1,288 homologous donors. No differences were found between the two groups when compared for HBsAg, RPR, ALT, anti-HIV, and HBcAb.

Meanwhile, Grossman, Stewart, and Grindon\(^{12}\) in a Rapid Communication, compared 413 autologous donors with 413 homologous donors using the markers of HBcAb, HBsAg, ALT, and anti-HIV. The median age of the autologous group was 44 years, and the median age of the homologous groups was 34 years. Men constituted 30 percent of the autologous group, but 57 percent of the homologous group. First-time donors represented 33 percent of the autologous group and 21 percent of the homologous group. An increased incidence of HBcAb was found in the autologous donors (3.2\(\times\)) when compared to the homologous group, but no other markers showed a difference. There was no disparity between the reactions of the first time donors and repeat donors of each type donor group.

Kruskall et al\(^{15}\) in a study involving both a blood center and a hospital, compared 2,211 autologous donors with 300,120 homologous donors. Markers used were anti-HIV, HBsAg, STS, ALT, HBcAb and donor history. Only the incidence of the STS was found to be higher in the autologous donors; however, all positive results were due to biologic false positive tests. This study is interesting since the incidence of positive donors was compared rather than units of blood. A subsequent editorial\(^{4}\) challenged this view. The communication stated that autologous donors give more frequently over a short period of time and thus contribute more units to the blood pool than the homologous donor who gives at longer intervals. If one of the autologous donors was in the "window" phase of any infectious disease, this would cause more units of blood in the total donor pool to be contaminated over a brief period of time. Therefore, true infectivity would be represented only by comparing units of blood.

In rebuttal Kruskall\(^{16}\) states that, given a rather significant rate of both false positive and false negative results with the surrogate marker tests, the use of blood units for comparison would skew the figures of the incidence of disease in a population. This is again challenged by AuBuchon and Dodd\(^{5}\) in the rebuttal statement. Certainly this is a debatable topic at this time and deserves to be considered in all such comparisons.

In another abstract by Toy et al\(^{29}\) 2,275 autologous units were compared with 150,798 homologous units drawn at three different centers. Markers studied were HBsAg, anti-HIV-WB, ALT, and HBcAb. The HBcAb and ALT markers were found to be elevated in the autologous donor (2.8 and 1.5\(\times\), respectively) in one of the three centers but not in the other two. The authors conclusion is that relative safety for crossover or autologous units may differ among regions.

A second part of Starkey's report\(^{27}\) also reviewed the safety of autologous donors as well as directed. Autologous donors were subdivided, when the information was available, into those patients whose blood units by history and hematocrit could be crossed over and those that could not. Only 17 of the 20 centers provided results on autologous donations. Of those, only 12 were able to separate the donations into units that could be crossed over by history and hematocrit and those that could not. A total of 11,940 autologous donations was compared against 444,637 homologous donations. The
markers studied were HBsAg, HBCab, anti-HIV, ALT, and RPR. The incidence of HBCab in autologous donors, who by history could be crossed over, was found to be $2.5 \times$ when compared with the total homologous donor group. Interestingly, as in the directed donor section of their work, no anti-HIV positive autologous donors were found in the group suitable for cross-over, while 0.01 percent of the homologous donors was reactive. In those donors acceptable for crossover, the risk factor for HBsAg was slightly elevated ($1.8 \times$). The risk factor for RPR was 3.5, but apparently these were studied to find out whether or not they were biological false positives. Mazzei et al report in a Letter to the Editor on studies performed in Italy on 250 units donated for autologous use and 350 donated for homologous use. They studied HBsAg, HBCab, ALT, VDRL, and anti-HIV. No significant differences in any of the markers were found between each group. They mention that some of these differences might be due to regional variations. Finally, Conover et al \textsuperscript{8} studied 1,476 autologous donations and compared them with 86,815 homologous. Using the new EIA test for Hepatitis C, the incidence of the Hepatitis C marker in autologous donors was found to be no more than in first time homologous blood donors. However, the group of donors with a positive history for transfusion had a higher incidence.

As is shown in tables I and II, the total number of autologous donors studied in all these reports was 22,671 and the total number of directed donors was 30,589.

**Discussion**

From the studies, it becomes apparent that there are great differences between the methods of analysis and the conclusions obtained in the different papers reported. This is made more difficult by the fact that all references except 19 are short papers with the analytical methods used either incompletely listed, or not stated at all.

Donors can be divided into three categories: (1) the autologous donor who gives for him/her self, (2) the directed donor who is requested by the patient to give blood to be used by the patient, and (3) the homologous donor who gives blood altruistically for whomever needs it. These groups must be further subdivided into three other groups: (a) the donor who is reactive with one or more of the markers for transfusion transmitted disease, (b) the first time donor, and (c) the repeat donor.

Each of these subgroups must be regarded differently. The reactive donor will be rejected, and the blood destroyed except in some cases of autologous donor-patients where it may be saved and used for that patient alone. The first time donor of all types has been shown to have a higher number of disease markers since he/she has never been tested before. However, these units, if positive, will be discarded, and the donor told not to give again except possibly for autologous use. The first time donor who is negative for markers is earnestly sought since this group of individuals will form the base of the new set of donors. However, there is a dichotomy in this regard. Some authors regard the first time donor who is giving as a directed donor to be suspect, while they greet the first time homologous donor with open arms. It would seem that these donors should be treated equally, particularly since an article by McVay et al \textsuperscript{18} documents that a significant percentage of first time autologous and directed donors return subsequently to give as homologous donors.

Lastly there is the multiple donor. If this donor gives as an autologous donor, again there seems some bias against the use of his blood, possibly because the donor has not been identified as such.
The homologous multiple donor is the backbone of the donor pool, since this individual returns again and again. The only fear of this individual is that during his/her life span, he/she may pick up some infectious disease and pass it on. If this infection is so recent that viremia is present, but the markers have not become reactive (the so called “window phase”), this individual’s blood will be accepted and will transmit disease. Most of the authors questioned that this may happen with the multiple directed donor, but this donor is used as the control group in all studies.

With directed donors, in two out of the six reported studies, no difference was found between the directed donors and homologous ones, while four show some difference, mainly in the HBcAb and ALT markers. In the autologous donor studies, five out of the 10 papers showed no difference in infectious disease markers between the autologous and the homologous group. The other five showed differences in the incidence of HBcAb, ALT, and biological false positive RPRs. All of these may be regarded as somewhat non-specific markers.

The use of ALT\textsuperscript{1} and HBcAb\textsuperscript{14} as “surrogate markers” for non-A, non-B hepatitis (NANB) was begun owing to the unavailability of a more specific marker. Aach et al\textsuperscript{1} proposed the use of ALT when their group found a relatively higher percentage of non-A, non-B hepatitis in those individuals who had received blood that had an elevated ALT. Their final statement was that “screening blood for ALT levels would reduce the incidence of non-A, non-B hepatitis.”\textsuperscript{1} They do admit that the test lacks both sensitivity and specificity but feel that at the time its use will help decrease NANB.

In a recent “Controversies in Transfusion Medicine,” Spurling and Saxena\textsuperscript{26} report the difficulties with this test. Obesity, strenuous exercise, alcohol consumption, and some medications (especially acetaminophen) cause abnormal levels. They cite a series of apheresis donors in which 43 were found to have one or more ALT elevations. All except three had made previously ALT-normal donations with an average of 5.4 donations each. Forty of the group were retested, and 10 had a second elevation. The other 30 were found to be acceptable then, and most have donated again. Thus, the analysis itself is not predictive and is influenced by many conditions other than NANB.

Koziol et al\textsuperscript{14} similarly proposed the use of HBcAb as a “surrogate” marker for NANB. Their postulate was that NANB carriers might be sequentially or concomitantly exposed to both hepatitis B and NANB, or that the viruses might have a common origin. Their study shows that 4.2 percent of patients receiving HBcAb negative blood developed NANB, while 11.9 percent of those receiving blood that was HBcAb positive developed NANB.

These two reports, and subsequent others, caused a clamor for some type of surrogate testing, and their use was required by most licensing agencies. Although the claim is made that only a small (variable) number of donors will be rejected with these two tests, some studies have shown a considerable number of rejections, especially in certain ethnic groups. It would seem that with the advent of specific Hepatitis C testing, surrogate testing would not be needed. This does not mean that there may not be more hepatitis viruses yet that need testing. A new generation of hepatitis C test has been seen and others will probably come along. However, surrogate testing must be shown to provide safety in these donors. The report of Carson et al\textsuperscript{6} has estimated the current risk of death owing to HIV from tested blood as being 3.3 to 26 per million, and the risk of hepatitis B as 0.075 percent. Their estimate of the risk of NANB hepatitis is one percent, and they feel that this will decrease to 0.3 percent per unit with the universal test-
ing for Hepatitis C. A comparable decrease (50 percent) is predicted by Alter et al\textsuperscript{2} as Hepatitis C screening is added to blood testing. However, ALT and HBcAb do not seem specific enough, and therefore do not seem cost-effective. In all blood donations, the donor who has an infectious disease marker either by history or laboratory exam has been tested and detected. Therefore, the main fear is that some of these donors will be in the "window phase" of a disease where the markers will not be detected, but the donor will be infectious. Further, an assumption is made that the incidence of this window phase parallels the occurrence of the detected markers in the different donor populations. While this seems intuitively correct, there are no studies to show that this is true, nor would this be an easy study to carry out. The estimates of Carson et al\textsuperscript{6} give us a better set of figures to work with.

If the HBcAb and ALT differences are regarded with less weight in the reported studies, it would appear that crossing over of units that are acceptable by the usual disease markers, history, and hemoglobin is acceptable in most cases. However, Toy et al\textsuperscript{29} has shown that the incidence of markers may vary considerably depending on the rate of the various infections in the population. Therefore, if one is to consider crossing over either autologous or directed donors into the general donor pool, one should derive the statistics of infectious markers for one's own area. The incidence of first time donors should be considered, and a determination made if their contribution to the pool is necessary and safe. One cannot borrow someone else's statistics and achieve a valid decision. Dzik and Devarahan\textsuperscript{10} have given a mathematical model that could be used to help make this decision.

References


