Prediction of Fainting in Blood Donors

By David T. Graham, M.D.

It seems probable that almost all of the so-called "reactions" in blood donors are partial or complete vasovagal faints. In a study of fainting, data were obtained from 414 consecutive blood donors before the drawing of blood was begun. It was hoped that some of the routine, easily obtained data from such persons would permit selection of donors who were likely to faint.

The major hypothesis under investigation is that vasovagal fainting is the second limb of a diphasic response. The first limb is characterized by increases in heart rate and blood pressure. If these phases occur as an emotional response, the first is part of anxiety, defined as the response to a threat, but the second is part of sudden relief from anxiety. The change from the first to the second phase occurs when the person sees himself as no longer threatened, either because danger has safely passed or because a threat has actually been carried out.

The hypothesis also suggested that cardiovascular indications of anxiety would be more prominent in those donors who subsequently fainted, than in those who did not. Systolic and diastolic blood pressure and pulse rate were routinely obtained in all prospective donors as part of the ordinary operation of the blood-donor room. Further, each prospective donor was asked whether or not he felt "nervous." This word was thought to be in actual usage nearly synonymous with "anxious," which many donors would not have understood. This was the only item of information that had to be especially gathered for this research. Data on race, age, sex, and previous blood donations were included in the study because they were obtained as part of the ordinary routine for blood donation.

Subjects

The subjects of the study were 414 blood donors at a hospital blood bank. These were consecutive, except for the exclusion of 81 for whom some information (usually the item about "nervousness") was missing from the record before donation. During the course of the study 495 donors actually were bled. Most of the donors had come in response to a request from the hospital to replace blood received by friends or relatives. A few were professional donors; data concerning them were not handled separately.

Procedure

The data were gathered by technicians regularly employed in the blood bank as well as by medical students who had part-time jobs there. No change was made in the existing system of recording information on separate cards for each donor, except that an additional note for the question about "nervousness" had to be made, which was no doubt the reason for its frequent omission.

At the conclusion of the donation, a note was made on a card if the donor had had a reaction. The definition of "reaction" used in this study was simply the presence of symptoms or signs of generalized discomfort (thus excluding pain at the venipuncture site, for instance) of sufficient severity that the donor either called them to the attention of the staff or that they were observed by the staff. They consisted chiefly of pallor, sweating, and disturbance of consciousness ranging from slight "lightheadedness" to complete unconsciousness. It is true that this definition may have caught a few examples of reactions other than vasovagal faints, but it is thought that these exceptions were few. The usual procedure for donors involved a wait of from 1 to 30 minutes outside the room in which the blood was actually drawn, during which time they checked off on their cards a list of symptoms or illnesses that might disqualify them. During this wait blood was obtained by a finger puncture for a rapid estimation of hemoglobin content. The donor then
Table 1
Relation of Variables Studied to Fainting Rate*

<table>
<thead>
<tr>
<th>Variable</th>
<th>% Fainted</th>
<th>Correlation with fainting</th>
<th>Statistical measure and value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negro</td>
<td>0.0</td>
<td></td>
<td>$x^2 = 11.74$</td>
<td>$p &lt; .01$</td>
</tr>
<tr>
<td>White</td>
<td>17.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>17.8</td>
<td></td>
<td>$x^2 &lt; 1.0$</td>
<td>Not significant</td>
</tr>
<tr>
<td>Women</td>
<td>18.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot;Nervousness&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot;Nervous&quot;</td>
<td>28.6</td>
<td></td>
<td>$x^2 = 6.65$</td>
<td>$p &lt; .01$</td>
</tr>
<tr>
<td>Not &quot;nervous&quot;</td>
<td>12.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Donation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First-time</td>
<td>22.4</td>
<td></td>
<td>$x^2 &lt; 1.0$</td>
<td>Not significant</td>
</tr>
<tr>
<td>Repeaters</td>
<td>16.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>before donation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blood pressure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systolic</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diastolic</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>before donation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pulse</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Except for race, all comparisons apply to white donors only.

lay down on an examining table and his pulse rate and blood pressure were determined.

Prospective donors were occasionally rejected before this point was reached because they gave a history of a disqualifying symptom or illness. In addition to a negative history in this respect, the major relevant criteria for acceptance were age between 18 and 60 inclusive, weight greater than 110 pounds, oral temperature 99.6 F. or less, pulse rate between 60 and 100 inclusive, systolic blood pressure between 100 and 200 mm. Hg, and diastolic less than 100 mm. Hg. Minor deviations from the pulse and blood pressure criteria were permitted at the discretion of a physician in attendance, especially if a few minutes' rest brought them within the acceptable range.

If the donor was acceptable, a tourniquet was placed around one arm, and a needle was inserted into the antecubital vein. The blood flowed into a collecting bag, which was out of his normal line of sight, but which he could see if he made an effort to do so. Approximately 520 ml. were withdrawn.

The time spent in the various stages of the process varied a good deal from donor to donor, depending on how taxed the staff and facilities were. The time actually required to collect the blood after the needle was inserted varied from about 6 to 15 or 20 minutes.

When collection had been completed, the donor was allowed to sit up if he felt well, was given milk or fruit juice to drink, and was then asked to sit for about 5 minutes outside the room to make sure no reaction would develop. A reaction occurring at any time was included in the final tabulation.

Results

All the reactions reported are referred to as "faints": 15.2 per cent of all donors fainted.

Race. None of the 62 Negro donors fainted, whereas 17.9 per cent of the 352 white donors fainted, a statistically significant difference (table 1). Since no faints occurred among the Negroes, this group is not included in analyses of the remaining data. All subsequent findings refer to the white donors only.

Sex. There were 54 women and 298 men among the white donors: 18.5 per cent of the women and 17.8 per cent of the men fainted. There was not a significant difference in fainting between the two sexes (table 1).

Age. There was a definite association between age and the occurrence of fainting: the younger the donor, the more likely he was to faint (table 2).

"Nervousness." "Nervousness" was admitted by 31.8 per cent of the white donors: 28.6 per cent of these "nervous" donors fainted. Of the remaining 68.2 per cent who denied "nervousness," 12.9 per cent fainted. A donor who admitted to anxiety was, there-

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fore, more than twice as likely to faint as one who denied it.

**Pulse Rate.** The pulse rate before donation also proved to be significantly related to subsequent fainting. Except for the very slow rates, the higher the pulse rate, the more likely was a faint to occur (table 3).

**Blood Pressure.** The blood pressure measurements are certainly not very accurate; there are, for instance, far too many readings in multiples of 10. Nevertheless, if an important relation between pressures and fainting existed, it would have been expected to appear. Neither systolic, diastolic, nor pulse pressure obtained before the blood donation was found to be correlated with subsequent occurrence of fainting. Mean blood pressure, estimated by the formula DBP + \( \frac{SBP-DBP}{3} \), also did not correlate with subsequent fainting (table 1).

**Previous Donation.** Eighty-five of the subjects gave blood for the first time; 267 had made previous donations. The difference in fainting between the two groups was not significant (table 1).

**Relations among Items.** The significant predictors of fainting are by no means completely independent of each other. Actual intercorrelations were not computed, but inspection of the data showed that "nervousness," youth, and high pulse rates tended to be present in the same donors.

On the other hand, there was enough independence so that, by combining the significant items, it was possible to define donor groups with very high probabilities of fainting (table 4). Naturally, the larger the number of faint-predictors required in a single person, the smaller is the group containing only such persons. There were, for example, only seven who were white, under 30, "nervous," and with pulse rates of 100 or more, but five of these fainted, a rate of 71.4 per cent.

**Discussion**

The number of donors studied here is small compared to some of the groups reported by others. The data appear to be meaningful, however, since the statistical evaluation of significance takes account of the size of the group.

A correlation between high pulse rates before blood donation, and vasovagal fainting later was obtained. There was no evidence of correlation between elevated blood pressure, as routinely determined before donation, and subsequent low blood pressure. Brown and McCormack\(^1\) mention that "high blood pressure and high pulse rate were often seen before bleeding" in donors who later fainted, but they did not investigate this relation systematically.

The relatively high frequency of fainty in donors with the lowest initial pulse rates, even though the total number in this group is small, runs counter to the trend in the rest of the subjects. A suggested explanation is that some of these donors had in fact already "begun to faint," so to speak, and that the low pulse rate reflects this fact. If this is true, the event that precipitated this kind of "partial faint" may have been the puncturing of the finger for the hemoglobin estimation. This seemed to be a threat of some importance to some very anxious per-

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**Table 2**

<table>
<thead>
<tr>
<th>Age</th>
<th>Proportion fainted</th>
</tr>
</thead>
<tbody>
<tr>
<td>50-59</td>
<td>0/21 = 0%</td>
</tr>
<tr>
<td>40-49</td>
<td>8/79 = 10%</td>
</tr>
<tr>
<td>30-39</td>
<td>24/125 = 19%</td>
</tr>
<tr>
<td>20-29</td>
<td>28/117 = 24%</td>
</tr>
<tr>
<td>10-19</td>
<td>3/10 = 30%</td>
</tr>
</tbody>
</table>

**Table 3**

<table>
<thead>
<tr>
<th>Pulse rate</th>
<th>Proportion fainted</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 100</td>
<td>15/35 = 43%</td>
</tr>
<tr>
<td>90-99</td>
<td>16/73 = 22%</td>
</tr>
<tr>
<td>80-89</td>
<td>21/155 = 14%</td>
</tr>
<tr>
<td>70-79</td>
<td>8/72 = 11%</td>
</tr>
<tr>
<td>60-69</td>
<td>4/17 = 24%</td>
</tr>
</tbody>
</table>

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sions, and, in fact, on rare occasions fainting is seen after it.

The over-all incidence of fainting in this study is surprisingly larger than that reported by others. No incidence greater than 7 per cent was found.\textsuperscript{1,8} It is not easy to be sure to what extent the groups of donors are comparable. The references cited above deal with blood-collection efforts in connection with war-time needs. A great many of the present donors were giving blood because close friends or relatives were seriously hurt or ill, and it seems likely that their anxiety about the blood-drawing itself might have been superimposed on a high level of anxiety already present for other reasons. It is also possible that in the present work milder reactions were counted than was true in other investigations, and also that there was more opportunity for close individual attention to donors and hence for observing reactions that might otherwise have passed unnoticed.

No mention has been found of low incidence of vasovagal fainting in general, or of blood donation "reactions" in particular, in Negroes. Reactions in Negro donors are sometimes seen in the blood-donor room where the present data were gathered, but the rate must be substantially lower than that for white subjects.

There is no obvious explanation of the racial difference found. Statistical evaluation showed no significant differences between the means of the two groups in age, initial pulse rate, systolic blood pressure, or mean blood pressure; or between the groups in sex distribution or admission of "nervousness." The Negro donors' mean diastolic pressure was 81 mm. Hg as opposed to the whites' 77. This difference is statistically significant (\(p<.01\)), but its meaning is doubtful in view of the lack of correlation between blood pressure and fainting in the white group. The Negroes' mean pulse pressure was 50 mm. Hg, the white persons' 53. The probability that this difference could arise by chance is less than 5 per cent, but, again, since there was no correlation in the white group between pulse pressure and fainting, it is doubtful that it helps to explain the racial difference in fainting. It is possible that the latter represents some kind of social or cultural artifact, having to do with the circumstances under which persons come to give blood. Certainly there seems no reason to think that anxiety is any less common in general among Negro than among white persons.

In other respects, in which the variables corresponded, the findings of the present study are generally concordant with those of others. Age has been four times previously reported to be negatively correlated with fainting in blood donors.\textsuperscript{2,5} One report\textsuperscript{6} denies such a relation. In it, however, the age groupings in handling the data are such that the correlation may be somewhat obscured; furthermore, its tables show that more fainting was in fact found in the youngest group than in the others.

There have been varied reports about the influence of sex on reaction rate in donors. One study\textsuperscript{5} showed a higher rate for young men than for young women, with little difference in older subjects; two, a higher rate for women than men;\textsuperscript{2,6} and two\textsuperscript{3,4} concluded that there was no difference, which agrees with the present data. The explanation of these disparities probably lies in differences in donor populations in such things as equality of age between sexes and whether the men had been rejected for military service.

No other investigators seem to have at-

\textbf{Table 4}

\begin{center}
\begin{tabular}{|c|c|c|}
\hline
& Pulse & Not "nervous" & 16/46 = 35\% Fainted \textsuperscript{1}\textsuperscript{6} \\
Age <30, & Pulse \geq 90, & & 11/23 = 48\% Fainted \textsuperscript{1}\textsuperscript{6} \\
Age <30, & Pulse \geq 90, & "Nervous" & 6/12 = 50\% Fainted \textsuperscript{1}\textsuperscript{6} \\
Age <30, & Pulse \geq 100, & Not "nervous" & 5/7 = 71\% Fainted \textsuperscript{1}\textsuperscript{6} \\
Age <30, & Pulse \geq 100, & "Nervous" & 4/7 = 50\% Fainted \textsuperscript{1}\textsuperscript{6} \\
\hline
\end{tabular}
\end{center}
tempted an objective assessment of the incidence of "nervousness" in their donors. When the word is mentioned,1,3 it is not clear to what extent the evaluation is by an observer and to what extent by the donor himself. Presumably, no matter who uses it, it refers to what would more precisely be called "anxiety." The higher rate of fainting in donors who admitted "nervousness" than in those who did not is of some general interest, apart from its value in predicting the occurrence of fainting. It indicates that, at least in this limited setting, a conscious statement about emotional status has real meaning, since it is useful in making a prediction.

Two previous reports1,6 are in agreement with this one in finding a slightly higher risk of fainting in first-time donors, although, as in this one, the difference was not striking.

Various other possible factors influencing the fainting rate have been examined by others. These did not, in general, appear to be of much assistance in prediction. It is worth mentioning, however, that Poles and Boycott,4 found a fainting rate of 8.5 per cent if 540 ml. of blood were removed, as opposed to 3.8 per cent if only 440 ml. were taken. One important piece of information is a history of previous fainting in any circumstances, which is mentioned in three reports1,3,6 as valuable in differentiating fainters from nonfainters among blood donors. This was not investigated in the present study.

Since serious consequences of donor faints must be extremely rare, preventing them is probably not a matter of great importance. Yet it does seem desirable to keep the rate as low as possible, and the results of this and previous studies do suggest some steps to take. In the first place, it is possible to recognize the donors who are most likely to faint, and therefore to concentrate preventive measures where they will do the most good. In the second place, it seems likely that steps to reduce anxiety before the insertion of the needle are crucial, and that after this point the process may be difficult to alter. A number of obvious possibilities exist in terms of verbal and nonverbal reassurance, manipulation of the atmosphere and operation of the blood-donor room, and so forth. Williams5 found that donors dealt with by inexperienced personnel had a fainting rate only about one third that of donors handled by experienced medical officers; he attributed this difference to the fact that the inexperienced persons were "constantly in personal touch with each donor."

Until actual experimentation is done, it is not possible to know what steps, if any, will reduce anxiety or the fainting rate, or both. Although studies like the present one show a correlation between indicators of anxiety and fainting, which are useful in prediction, they do not by themselves establish that fainting would not occur if the anxiety were reduced; it is theoretically possible (although not the author's opinion) that the anxiety and the subsequent fainting are not directly linked, but rather that they both reflect some third, unknown variable.

Summary

Four hundred and fourteen consecutive blood donors to a hospital blood bank were studied to discover items of value in predicting the occurrence of "reactions." Since it is probable that blood donor "reactions" are almost always vasovagal faints, they are so referred to below.

Several items of predictive value were found: none of the 62 Negroes, but 63 of the 352 white persons fainted; the younger the donor, the more likely a faint; the higher the resting pulse rate before venipuncture, the more likely a faint; admission of "nervousness" was associated with greater chance of fainting than was denial.

Sex, resting blood pressure before venipuncture, and history of previous blood donation did not significantly differentiate fainters from nonfainters.

The data are compatible with the hypothesis that vasovagal fainting in blood donors is the second limb of a diphasic response, and is part of relief from anxiety; the first limb is part of anxiety proper.
Acknowledgment
Thanks are expressed to Olivia J. Pautler for technical assistance.

References

Then, to gain some idea of the quantity of air that was actually taken into the body during breathing, he constructed inspiratory and expiratory valves, and inspired a measured volume of air out of a container; at the same time he collected all his expired air over water (Plate IX, fig. A). On returning his expired air back into the container, he found that 1/136th of its original volume had disappeared.—A. E. Clark-Kennedy, M.D., M.R.C.P. Stephen Hales, D.D., F.R.S. Cambridge, University Press, 1929, p. 102.
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