Staff Meeting Bulletin Hospitals of the » » » University of Minnesota

Blood Bank Problems

ume XIII Friday, January 9, 1942 Number 11

STAFF MEETING BULLETIN
HOSPITALS OF THE . . .
UNIVERSITY OF MINNESOTA

Volume XIII | Friday, January 9, 1942 | Number 11

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Published for the General Staff Meeting each week during the school year, October to June, inclusive.

Financed by the Citizens Aid Society, Alumni and Friends.

William A. O'Brien, M.D.

LAST WEEK

Date: December 12, 1941

Place: Recreation Room,
Powell Hall

Time: 12:15 to 1:00 P.M.

Program: "Transurethral Resection"
C. D. Creevy
B. A. Smith
G. F. Malin

Discussion
C. D. Creevy
Wesley Spink
Owen H. Wangensteen
B. A. Smith

Present: 141

Gertrude Gunn,
Record Librarian

- - -

II. ANNOUNCEMENTS

1. PROTEIN SEMINAR

Department of Physiology

The program for the series of Seminars on "The Structure and Behavior of the Proteins" during the remainder of the year has been revised as follows:

Jan. 8 and 15. Titration and Charge Studies, Prof. L. S. Moyer.
Jan. 22. Electrophoretic Studies of Complex Protein Mixtures, Dr. L. G. Longsworth, Rockefeller Institute, New York City.
Jan. 29. Evidence for Zwitterion Structure of Proteins, Prof. B. L. Crawford.
Feb. 5. Double Refraction in Proteins, Dr. W. Heller.
Feb. 19. X-ray Diffraction Studies in Crystalline Proteins, Dr. I. Fankuchen.
Feb. 26. X-ray Diffraction Studies in Virus Proteins, Dr. I. Fankuchen.
Mar. 5. Fundamental Studies of Allergens, Prof. H. A. Abramson, Columbia University, New York City.
Mar. 12. Virus Protein Studies, Prof. M. H. Roepke.
Mar. 19. Plant Protein Studies, Prof. R. A. Gortner.
Mar. 26. Interaction of Proteins in Solution and at Surfaces, Prof. L. S. Moyer.

The meetings will be held at 8 p.m. on the days listed in Room 15, Medical Sciences.

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2. PATHOLOGY SEMINAR

12:30 p.m., Monday, Jan.12, 1942, 104 Institute of Anatomy.
Paradoxical embolism.
Dr. J. S. McCartney, Jr.

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3. EMERGENCY COURSE IN SURGERY

Program
Personal experiences with civilian and military surgical problems in present war.
Crushing injuries.
Wounds and infections of extremities.
Shock.
Plasma, serum, and blood transfusions.
Burns.
Fractures.
Poisonous gases.
Ballistics.
Injuries of head, eye, face, chest, abdomen, genito-urinary system, spine, nerve and blood vessels.
Anesthesia.
Teaching first aid.
Surgical conferences and others.

Faculty
O. H. Wangensteen
Wallace H. Cole
Frederick A. Collier (University of Michigan)
And 25 associates.

- - - - -

BLOOD BANK PROBLEMS

Milton Levine

The widespread use of stored blood, serum, and plasma in the treatment of anemia and shock necessitates frequent attempts at correlation of the results obtained with such therapy. Furthermore, the national emergency will tax our present transfusion facilities, and at the same time will extend the use of stored blood so that every clinician must be made aware of the principles, the hazards, and the advantages of the various procedures involved. The urgency of the problem seems to justify a discussion of the fundamentals even at the risk of boring by repetition.

Historically, serious consideration of the possibility of storing blood for transfusions began with the work of Rous and Turner[1] at the Rockefeller Institute, who developed the first preservative solution. Their blood-dextrose-citrate mixture was tried on a practical scale by Robertson[2] at the casualty clearing stations of the Third Army, B.E.F., during the World War I. However, this work was forgotten until a group of Russian investigators[3] began to employ stored blood in civilian cases. Their results, together with those obtained in the Spanish Civil War, and the favorable reports of its use for the first time in the United States, at the Cook County Hospital[4] have established the therapeutic status of stored blood for both military and civilian needs.

In the field of transfusions, the bacteriologist is concerned with the preservation of the blood, and with the serological aspects of compatibility. Eliminating gross transfusion reactions due to incompatible groups is not his only problem, but it is an important one. Reactions due to incompatibility of the main blood groups (O, A, B, AB) are inexcusable, since correct grouping and cross-matching should eliminate entirely this type of reaction. Despite the simplicity of the tests involved, however, such reactions do occur. We have had 1 such accident in the past 2 years. It might be instructive to describe it in detail.

The donor's blood was grouped with the human grouping sera used routinely. It was a group A blood which was wrongly placed in group O. As such, it was cross-matched with the serum of a patient in group B. Normally the incorrect groupings are eliminated in the cross-matching test, but in this case hemolysis resulted, leaving but a few dispersed cells in the microscopic field, and the technician reported non-agglutination. The hemolysis test, which is run with each cross-matching, was omitted in this case because the intern felt that the transfusion could not be postponed for the 1-hour period necessary to run the test which would have exposed the incompatibility of the blood. Fortunately, the administration of the blood was stopped before a fatality resulted.

Despite the elimination of reactions due to group incompatibility, reactions due to other factors still occur. Most of these reactions are minor, but occasional fatal ones have been observed. The reactions which may be encountered are as follows:

A. Mild:
1. fever
2. fever and chills
3. chills alone
4. urticaria
5. rigor

B. Severe:
1. nausea
2. vomiting
3. hemoglobinuria
4. jaundice
5. oliguria
6. stupor
7. uremia

The reaction rate varies with the institution involved and with the interpretation of what constitutes a reaction. In general, however, it is customary to have a 5 to 10 per cent reaction rate of the minor varieties, and less than 1 per cent of the more severe forms. DeGowin[5], who has contributed much to the knowledge of the subject by his research on the preservation and

istration of stored whole blood, has ged to reduce his total reaction rate 5.6 per cent. Other workers have been s fortunate.

What are the factors influencing the te of reactions? It is best to discuss ch one individually as to its back-ground and importance at the University Hospitals.

Pyrogens

The work of Seibert[6] and others has demonstrated that numerous species of bacteria, mostly nonpathogenic, are capable of growing in solutions of all sorts, in rubber tubing, on the sides of glass containers, and in fact, in practically any environment. These bacteria give rise to substances which cause chills and fever when introduced intravenously into animals and man. The factors responsible for this reaction have been lumped into a heterogeneous group called the pyrogens. These substances are responsible for the reactions we obtain from intravenous solutions, and no doubt, for a great many resulting from the administration of stored blood. The pyrogens are not inactivated by sterilization, so that, if bacteria make contact with the blood, the collecting apparatus, the preservative, or the anti-coagulant solution at any point before sterilization, there is a great possibility of pyrogens being present in the final product. The rubber tubing, the needles, and the collecting bottles must be washed carefully to rid them of organic matter, and then must be rinsed in double distilled water. (Distilled water contains pyrogens if the still permits stagnation, or back-streaming of the water, or if the water is exposed to the air too long).

The citrate must be checked for microorganisms, which will grow anywhere, even in concentrated phenol. The water and the washed apparatus should be sterilized immediately after preparation. DeGowin[7] found that rubber tubing which was allowed to drain for 18 hours before sterilization was responsible for a high incidence of reaction in blood transfusions, which coincided with a rise in the number of reactions following the administration of intravenous fluids. Rapid drying and autoclaving of the tubing caused a precipitate drop in the number of reactions.

At the University Hospitals, continuous checks have been run on apparatus and fluids aiming toward the elimination of pyrogens. Despite these precautions, occasional reactions still occur from the administration of intravenous solutions, (more frequently in summer months). Therefore, if pyrogens have not been eliminated from intravenous solutions, they must be regarded as an important contributing cause of blood transfusion reactions.

Hemolysis

It is difficult to assess the role of hemolysis as a cause of transfusion reactions. It has been conclusively demonstrated by DeGowin[8] and others that the amount of hemoglobin in the supernatant plasma increases with the increase in the time of storage. The release of hemoglobin from the red cells is relatively slight up to 10 days after the blood is drawn. A maximum of 100 mgm. per 100 cc. plasma is reached at the end of 10 days. It then accelerates until it may reach 5000 mgm. per 100 cc. of plasma at the end of 35 days. Despite this fact, DeGowin[9], Muether[9] and others have found no significant differences in the number of transfusion reactions caused by blood stored for varying periods of time up to 38 days. If it were demonstrated (which it is not) that old blood gives a larger percentage of reactions than freshly drawn blood, it would not necessarily mean that the hemoglobin is at fault, since a number of other products are formed by the disintegrating cells, along with the hemoglobin. We have administered laked blood with a hemoglobin content as high as 125 mgm. per cent, and Watson[10] and others have injected pure hemoglobin into patients without any untoward reaction. It is our opinion that moderate hemolysis, in itself, is unimportant as a cause of reactions. It is, however, of importance in the therapy of conditions requiring red cell replenishment. We must consider, therefore, such factors

cell fragility, hemolysis, and poor cell survival in the recipient. Muether[11] has thrown some light on the situation; he demonstrated that mechanical fragility of the cells increases rapidly up to 5 days after storage, and then stabilizes at a constant level for the next 30 days. Bull and Drew[12] found the red cell count to remain about the same for 15 days, and then to decrease by from 1 to 1½ million cells by the end of 1 month. Philip Levine[13] has contributed an interesting and pertinent observation on the survival of transfused red cells. Identifying the donor cells by means of the M and N factors, he found that cells stored 3, 10, or 14 days survived in the recipient for 80, 60, or 20 days, respectively, as compared with cells of fresh blood, which were still present in the recipient 95 days after transfusion. Thus the patient's syndrome must be considered in determining the importance of the length of storage of the blood to be administered.

To cut down on the rate of deterioration of the cells, various methods have been suggested. Of the greatest importance is the temperature at which the blood is stored; since rate of deterioration increased with an increase in temperature. Most laboratories, including our own, keep blood at from 2 - 8°C. Blood kept at room temperature will deteriorate rapidly within 24 hours. This has been observed by every intern who has "forgotten" an unused bottle of blood in the operating room, and then has timidly returned the obviously hemolyzed blood to the ice box. Scudder[14] has introduced a special bottle which exposes a minimum of blood surface to the air. He has found that deterioration occurs less rapidly in such bottles than in ordinary flasks. Scudder has also advocated the use of an atmosphere of CO_2 to prevent deterioration due to oxygen exposure. A number of workers have demonstrated that agitation increases the rate of disintegration.

Of importance, also, is the solution in which the blood is collected. DeGowin[8] demonstrated the superiority of a dextrose-citrate-blood mixture over a plain citrate mixture as a preservative solution. The difference in the hemolysis rate, however, only becomes significant after the blood has been stored for 10 days. We have not used this preservative at the University Hospitals because all the blood administered is less than 10 days old. The slight advantage of the dextrose solution in blood stored for less than 10 days is counterbalanced by the increase in the volume stored (650 cc. of 5.4% dextrose, 100 cc. of 3.2% sodium citrate, and 500 cc. blood are contained in the mixture, a total of 1250 cc.). In addition, the separate autoclaving of the citrate and the dextrose requires twice as many flasks and doubles the amount of preliminary work in preparing the collecting apparatus. All this makes it advisable for us to use citrate along as a preservative solution, and necessitates the use of the most recently drawn blood for those patients requiring red cell replenishment.

Chemical changes.

Scudder[14] has attached great significance to the potassium which diffuses out of the erythrocytes during storage. He has shown that the potassium level in the supernatant plasma increases progressively with time. At the end of 10 days, there are about 50 mgm. per cent of potassium in the supernatant plasma. At the end of 30 days, the potassium level has reached an average of 100 mgm. per cent. Practically, however, DeGowin[15] has demonstrated that potassium is not important in transfusions of stored blood. I quote his clear conclusions based on actual test administration of bloods with high potassium levels:

> "The high plasma potassium content in blood preserved for thirdy days is not toxic when the blood mixture is transfused into human beings at velocities of less than 43.3 cc. per minute. The concentrations of plasma potassium encountered in blood stored for one month are not high enough to cause significant increases in the serum potassium of the recipient."

Muether[16] confirms this opinion and cites as further evidence the use of

stored blood in 2 cases of Addison's disease in crisis without a reaction resulting.

Rhoads and Panzer[17] and Quick[18] have found that prothrombin of stored blood diminishes on standing and they suggest that such blood is inferior to fresh blood in controlling bleeding in jaundice.

Scudder[14] has demonstrated a change on storage in the electrophoretic pattern of the blood proteins. Other workers have shown a decrease on standing of the leukocytes and complement. All these factors must first be shown to be necessary before we can even consider them as important in specific diseases. At present, they seem to be insignificant in the treatment of shock, and only of theoretical significance in other conditions.

Bacterial contamination.

The reports of recent efforts to supply blood for the present emergency indicate that bacterial contamination is the single most important factor to be controlled in eliminating transfusion reactions. These same reports also indicate that is not so easily done as one might imagine. Only a completely closed system from donor to recipient will prevent contamination, and such a system is manifestly impractical even if possible. It then becomes necessary to minimize exposure of the blood to bacteria, which may come from the air or from contaminated surfaces. Secondly, it becomes essential to prevent the multiplication of bacteria which may enter the blood despite all precautions.

To minimize exposure, the blood bottle should be capped immediately after collection of the blood, and should not be opened unnecessarily. We have observed inexcusable delay in capping bottles once the tubing has been removed. We have also observed a delay in administration of the blood after it has been filtered through gauze in an open room. These things should be considered when blood is administered or drawn. The insertion of the hypodermic needle into the donor's vein offers an opportunity for the introduction of bacteria from the well contaminated skin. Thorough application of the bichloride-acetone-alcohol solution (Novak's solution) before insertion of the needle will help eliminate this step as a source of bacterial contamination.

The filtering process is not advisable from the point of view of sterility, but until further studies demonstrate a simpler and safer method of eliminating fibrin clots, this procedure will have to be tolerated. Citrate is not a perfect anti-coagulant, and clots will form.

Novak[19] first described the use of sulfanilamide in the preservation of stored blood. He found that the bacteriostatic properties of this drug in amounts "compatible with intravenous dosage," inhibited the growth of organisms normally found as contaminants in the blood. Before the routine use of this drug at the University Hospitals, contaminated bottles were not uncommon. Since its introduction (0.1 gram for every 500 cc. of blood), there has not been a single contaminated sample in the more than 5 million cc. transfused in the past 3 years. Every blood reported to cause a reaction has been tested bacteriologically with consistently negative results. It must be emphasized that all the blood was less than 10 days old, and during this period the bacteriostatic action of the drug is assisted by the leukocytes and natural bactericidal substances in the blood. In older bloods the disintegration of these factors may make the sulfanilamide less effective.

Iso-Antibodies

The importance of isohemagglutinins in donor blood as a cause of reactions is a problem which still remains to be solved. There is a large amount of work indicating that blood from a universal donor is harmless when given to a patient of any blood group. More recently, experience derived from the use of plasma and serum has added to the evidence indicating that the isohemagglutinins in administered blood, plasma, or serum are of negligible importance. Nevertheless we must consider isolated instances

...re the titer of anti-A and anti-B ...glutinins has been extremely high, ...aching 500 or more. Gesse[20] has ...blished the most complete study on ...his phase of transfusion reactions. ...e described 46 cases of shock following ...dministration of universal blood; 20 of ...hese were fatal. New York state has ...lso recognized the possibilities involved and adopted a sanitary code regulation requiring group O blood to be titrated before use in order to eliminate bloods with a high titer of isohemagglutinins. To counteract the deleterious effects of universal blood, Witebsky and his co-workers[21] have introduced antigenically specific A and B substances which neutralize the homologous hemagglutinins when added to whole O blood. We have used these substances on 15 patients and have noticed no untoward reactions on the administration of the treated universal blood. Titration of the bloods before and after adding the specific substances revealed the anti-A and anti-B agglutinins in group O blood were almost completely removed. Further work is necessary to demonstrate conclusively the dangers attached to the use of group O blood, and the benefits to be derived from Witebsky's substances. The use of universal blood in infants and children is more to be questioned than its use in adults, since the dilution factor is not so great in young children.

In 1940, Landsteiner and Weiner[22] demonstrated a factor in human cells which corresponds to a similar substance in the erythrocytes of the Rhesus monkey. This factor (Rh) is undoubtedly responsible for fatal reactions in humans after repeated transfusion[23]. In this respect, it is like the M and N factors, but unlike these, it is not easily demonstrated in a crossmatching. In a later paper[24] Wiener has described a method for detecting the presence of the Rh factor by the use of guinea pig antiserum. Whether the same method can be used in a cross-matching remains to be seen. It may be necessary to test each blood for Rh factor before transfusion to prevent the administration of Rh + blood to Rh patients, but at present the materials for such a routine test are not available. The guinea pig is not an entirely satisfactory animal, according to Wiener, and a better animal is needed before the antiserum may be used routinely.

The demonstration of the Rh factor suggests the possibility of other similar but as yet unknown substances being responsible for reactions in repeated transfusions. Further experimental work is obviously necessary.

Allergic Factors

Frequently, following a transfusion, recipients have demonstrated symptoms indicating an allergic response to the transfusion. The most common sign is a generalized urticaria. DeGowin[5] could find no relationship between this reaction and a history of allergy in the patient. However, this does not disprove the allergic nature of the condition. Many have recognized the theoretical possibilities of the transfer of allergens in the transfused blood. This has been responsible for the requirement of many hospitals that fasting donors be used exclusively. Such transferred allergins would give an urticaria if associated only with a skin sensitivity, but no other allergic manifestations. Under such a condition, a history for allergy might well be negative.

At the University Hospitals we have not required fasting from donors. This would be impractical, since all the donors are friends or relatives of the patients, and have been difficult to obtain even without prerequisites. The imposition of fasting previous to drawing blood would cut our present supply considerably. However, if a new source of supply is obtained, such a procedure should be endorced, although the time factor would be arbitrary at best. At Dr. C. J. Watson's suggestion, we have recently inaugurated the practice of marking the fasting time on the label of the blood bottle. This has been done so that patients with allergic histories may receive bloods drawn as long as possible after a donor's meal.

The Blood Bank at the University Hospitals

Blood is drawn by interns of the individual services and given to the blood bank. This blood is credited to the service There is as much blood in the bank as is credited to all the services. Blood is released from the bank upon receipt of a written request for a cross-matching with the patient's serum. It is given out regardless of the individual from whom it was drawn or the service to which it is credited.

The blood is kept at from 2° to 8°C., and is labeled as follows:

DATA ON BLOOD FOR TRANSFUSION

Group _____ Date _____

For _____

From _____ Age _____

Doctor _____

Space for Laboratory Below

Kline _____ Date _____

Fasting Time _____

Before administration, each blood is cross-matched with the patient's serum for agglutination and hemolysis. The agglutination test is run by using a drop of a suspension of the donor's cells plus a drop of the patient's serum. This is incubated on a slide for 15 minutes at room temperature, and read as to whether agglutination or rouleaux has occurred. The hemolysis test consists of combining equal portions of patient's serum and donor cell suspension in a test tube at 37°C. for 1 hour. The test is then read as to hemolysis or non-hemolysis. We run both tests as a double check, and because some workers[25] have suggested the presence in incompatible bloods of isohemolysins independent of isohemagglutinins.

Bloods are not used if agglutination, rouleaux or hemolysis occurs. The detrimental effect of rouleauxed blood has never been demonstrated, but we have not been able to convince the clinicians of this. Many bloods require numerous cross-matchings because of rouleaux formation, and as a result much extra work is involved.

A Kolmo diagnostic test for syphilis is run on each blood in the bank. The sensitivity of this test is thought to be sufficient for this purpose. We have numerous false positives, which are checked with the Wassermann and Kahn tests before being used. A 1+ Kline with a negative Wassermann and Kahn is considered safe for use. A sample showing a 2+ Kline confirmed by the State Board of Health is not used. There is every indication that the possibility of transfer of syphilis by stored citrated blood is almost negligible after 24 hours of storage, and impossible after storage for 3 days. Experimental work has demonstrated that virulent spirochetes introduced into stored blood are eliminated in from 48 to 72 hours. Considering the number which might be present in circulating blood, and the fact that most of our blood stands for at least 24 hours, the possibility of a Kline negative blood causing syphilis in the recipient becomes remote, although not impossible.

Until recently we ran sterility tests on all bloods in the bank at the end of 5 and 10 days' storage. Since these were consistently negative (over a two-year period), we eliminated the test except on occasional bloods. We have done this because the test for sterility itself introduces a source of contamination. Tests of all bloods causing reactions have failed to demonstrate a single contaminated specimen.

A few words about the apparatus are necessary for those who are interested in the practical aspects of the problem. Until recently, we used the Abbott solution bottle. Priorities interfered with the production of the aluminum caps used for final storage of these flasks, and we had to switch to a new container put out by the Upjohn Laboratories. The latter apparatus uses a square bottle

ich conserves storage space, and a lastic cap for final storage. It has he disadvantage of a complicated "well" or drawing the blood, which introduces nother piece of apparatus to be cleaned. owever, it is, in our opinion, the most atisfactory apparatus available at present.

Within the past 2 months we have attempted to set up a recording system to provide data for a statistical study of the factors involved in transfusion reactions. Since the laboratory stores both whole blood and plasma, separate blanks are provided for each type of transfusion. The information required is evident from an examination of the blanks.

UNIVERSITY OF MINNESOTA
University of Minnesota Hospitals

Plasma Transfusion Record

Patient's Name _____ No. _____ Station _____

Blood Group _____ Diagnosis _____

Donors (1) _____ Date _____ Blood Group _____

(2) _____ Date _____ _____

(3) _____ Date _____ _____

Checked by _____
Interne

Amount of Plasma Given..... _____ Date _____

Amount of Saline Given..... _____

Amount of Dextrose Given..... _____ % _____

Time Begun..... _____ Discontinued _____

Pulse.....Before: _____ after: _____

Temperature.....Before: _____ After: _____

Reaction: _____

_____

_____

_____

_____

_____

Note: All reactions are to be reported immediately to the Blood Laboratory, and plasma is to be sent at once to the Laboratory.

UNIVERSITY OF MINNESOTA
University of Minnesota Hospitals
Blood Transfusion Record

Patient's Name _____ No. _____ Station _____

Blood Group _____ Diagnosis _____

Donor's Name _____ Donor's Blood Group _____

Date Blood Drawn _____

Hours after Meal _____ Checked by _____ Interne

Saline Test _____ Checked by _____ Technician

Cross Agglutination _____

Amount of Blood Given..... _____ Date _____

Amount of Saline Given..... _____

Amount of Dextrose Given.... _____ % _____

Time Begun..... _____ Discontinued _____

Pulse.....Before: _____ After: _____

Temperature.....Before: _____ After: _____

Reaction: _____

Note: All reactions are to be reported immediately to the Blood Laboratory, and blood is to be sent at once to the Laboratory.

It is too early to give a complete analysis of the data collected to date. However, some of the results are of interest. Of 377 consecutive bottles of blood transfused, the age of the blood is given in Table I.

Table I

Age of Blood in Days	Number of Bottles Given
1	94
2	57
3	63
4	46
5	36
6	29
7	26
8	16
9	7
10	3
	377

Of the total, approximately 60 per cent were 5 days old or less. This would indicate, as we have stated previously, a rapid turnover of blood. The reaction rate of a consecutive series of 522 whole blood transfusions was 4.2 per cent. Of the 22 bottles causing a reaction, 8 gave repeated reactions in 3 patients. One patient developed chills and a rise in temperature after each of 4 bottles administered. Two patients developed these same symptoms after each of 4 bottles of transfused whole blood.

If we compare this with the reaction rate of 149 plasma transfusions (22,350 cc.), we find that the plasma has an advantage, which, however, must be strengthened by a larger and statistically more reliable series before any definite comparison can be made between whole blood and plasma. The reaction rate in the plasma series was 2.0 per cent, 3 of the 149 transfusions giving rise to reactions.

The types of reactions encountered are shown in Table II.

Table II.

Reactions from Whole Blood

Type of Reaction	Number of Patients
Chill and fever	10
Chill	9
Spasms and chill	1
Edema	1
Itching	1

In addition to the above symptoms, 3 patients complained of nausea, 1 of back pain, 1 of a "prickly feeling" in the back, and 4 of headache. Only 2 of the 22 reactions following the transfusion of whole blood involved heterologous groups. In these cases, a group O blood was given to a group A patient. That this was not responsible for the reaction is indicated by the fact that both of these reactions were in the 1 patient who also reacted adversely to each of 2 homologous bloods.

Each time a reaction occurred, the blood was cross-matched again, and tested for sterility. In all cases, the results were negative. The fact that some individual patients react with many bloods at different times would indicate that the reaction is associated with some condition in the recipient. That this may be a developed immunity to some factor in the donor blood is suggested by the fact that many of the repeated reactors have had previous transfusions. In the 1 case with 4 reactions to 4 different bloods, the patient was suffering from aplastic anemia, and had been transfused many times before being studied in the present series.

It is beyond the scope of this report to give a comprehensive discussion on the use of plasma and serum as well as whole blood. Within the last year we have been supplying plasma on demand to all services. The plasma is drawn off whole blood which has stood in the refrigerator until the red cells have settled to the bottom. The plasma is syphoned off the cells and is used immediately after preparation.

All precautions for sterility are observed, but we realize that only a closed system would be entirely satisfactory. Since this is impractical and since filtering of plasma is a task requiring facilities not available to us, we have resorted to the use of freshly drawn plasma transferred in a closed room under a bactericidal ultra-violet lamp.

It is our opinion that this method of obtaining plasma is satisfactory for the present demands of the average hospital. If storage is required, a new problem arises. The simplest method of storing serum or plasma is by rapid freezing and storage at sub-zero temperatures. We have tried this method on plasma, with the aid of Dr. Hoyt and the Human Serum Laboratory, and have found it satisfactory providing the niceties of the freezing and thawing procedures are observed.

If the plasma is not frozen in a shell in CO_2 ice, it yields fibrin clots when thawed out. If it is so frozen,

at sub-zero temperatures, and ed out at 37°C., the final product entirely satisfactory and gives rise no reactions.

It must be remembered that frozen sma will permit the growth of bacteria ter the thawing process begins, so the asma should be used almost immediately ter thawing. There is a hazard of ntamination in this type of preserva- ion which must always be kept in mind. more satisfactory way would be to fil- r the plasma before freezing. The most esirable procedure involves the filtering, freezing, and drying of plas- a or serum, which method will eventually replace all others when facilities are available.

The serum versus plasma controversy is one which has more of a partisan than a scientific basis. There is no reason to believe serum to be more toxic than plas- a as is claimed by the proponents of the use of the latter. Nor is the evidence of the serum group any more reliable when directed against the use of plasma. It would seem from an examination of the figures on both serum and plasma trans- fusions that both are better than whole blood in that they cause fewer reactions. There is, however, no statistically sound information available as to which form (dry or wet, frozen or unfrozen) of serum or plasma is preferable.

No doubt much has been omitted in the above discussion, but it is a fault in- herent in so comprehensive a field. We have tried to point out that a fundamen- tal scientific approach to the subject of blood storage and transfusion is essential if we are to get rid of the many super- stitions associated with it. We have tried to introduce method into the blood service at the University Hospitals by means of a system of records. Cooperation has been excellent at all times, although many of the interns have voiced doubts as to the necessity for so much clerical work on their part. We trust that the above discussion may relieve some of their doubts.

There are a number of questions to be answered by those who may be interested in the problem:

1. Do allergins cause the allergic re- action observed (urticaria, itching)?

2. Are there pyrogens present in blood causing some of the reactions?

3. Are there factors similar to but distinct from the Rh factor causing occasional reactions?

4. Why do repeated reactions occur in some patients?

5. Would skin tests with the plasma prove anything?

6. Which is better, serum or plasma, frozen, dried, or moist?

Many other questions arise, and many problems remain to be solved. It is a step forward to recognize their existence.

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IV. GOSSIP

The Christmas holidays have come and gone, and they were happy occasions for all. The patients, especially the children at the hospital, were remembered by the Minneapolis Traffic Club with an elaborate program. The festivities started with the trimming of the trees and the annual Traffic Club dinner which was held at the Coffman Memorial Union this year. The children's wants were carefully collected in advance of Santa Claus' coming by his willing little helper who under other circumstances is known as Dorothy Jones. The Traffic Club continued the custom of giving each child at least one present they requested. For most of our children this was the first time this has happened and for some of them it will be the last time because the nature of their illness is such that they will probably not be here next year. There was the annual party for the children and Christmas baskets for everyone, young and old. There are not many institutions which have conducted for them such a complete program as is provided by the Traffic Club. The nurses have a good time with their Christmas festivities.

Superintendent R. M. Amberg took us along this year (paid applause). We went to an entertaining program, saw Santa Claus come (he gave us all presents), and finally partook of the elabo-

the supper at the end.

Most of the staff spent their holidays with their families as much as possible. It seemed that the spirit of everyone was subdued - that this seemed the appropriate thing to do.

The cold weather intervened to give us all an opportunity to exercise our appetites, without the possibility of adding more to already considerable girths. The papers have been vieing with one another to get opinions on how much one should eat during cold weather. Neuro-surgeon William T. Peyton seized the opportunity to resurrect his sour-dough buckwheat cake recipe and paid an official visit to our home to bring us some. Many people have fond memories of this particular dish. We can heartily recommend Dr. Peyton's recipe to anyone who wants to get the old-style tang. We had salmon from Seattle and sausage from Milwaukee, with California fruitcake from San Diego. I went with the children on a trip from Minneapolis to St. Paul on the Northwestern's "400." We made the regulation wait in the station before the train was called. A large crowd was waiting, and the train ran in two sections. A trip through the train, and then we found seats with everyone at a window. One of the high points of interest was pointing out familiar objects and buildings as we passed. In St. Paul there was another large crowd returning after the holidays. Another trip through the station and finally a streetcar ride home. Most of us still find it pleasant to take a train trip. This 10-mile ride has all the good features plus none of the boredom for the little fellows.

Everyone on the staff seems to be in good health and spirits. Special meetings of the administrative committee revealed that beneath this apparently calm exterior there is a determined effort to be of service to our country in her hour of need. The incoming freshman class will start in June and continue without interruption until graduation 3 years hence. This will be followed by the required internship if conditions permit. All classes will be accelerated at the same rate, and only the details remain to be worked out. Many wonder when the Base Hospital will be called, for when this order comes it will take from us many of our staff men. Everyone hopes that the new junior-senior teaching program can go into effect as anticipated, but it may mean that certain adjustments must be made. Dean H. S. Diehl is ably representing the medical profession in Washington on the Assignment and Procurement Committee. The secretary of the committee is also one of our Minnesota graduates.

The courses at the Center for Continuation Study will be continued with change in emphasis and types of programs. At the present time the county public health and tuberculosis district public health nurses are at school there. Their last day will be devoted to instructions on how to teach courses in Red Cross Home nursing. The Emergency Surgery course program is listed in another part of this bulletin. The course in Hospital Administration will have definite emphasis on preparedness. A study of the interests of the administrators showed that nursing education and service was one of their main problems. How to solve this problem will be one of the main topics for discussion. Other subjects will be: business management, public relations, standardized procedures, service departments, the dietary, and medical records.

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