differences in the heat loss per unit area and in the tissue conduction. The heat production for the men and women was the same up to 27.5°C, but in contrast to the men, the women showed a significant decrease in heat production at temperatures above this level.

10583

Quantitative Study of Effect of Transfusion of Blood on Plasma Prothrombin.*

JERE W. LORD, JR., WILLIAM DEW. ANDRUS AND ROBERT A. MOORE.

From the Department of Surgery and Department of Pathology, New York Hospital and Cornell University Medical College.

It is established that the bleeding tendency in obstructive jaundice and biliary fistula is due to a lowering of the plasma prothrombin. Both on clinical[1] and experimental[2] grounds, blood transfusion is known to effect temporary improvement in the hemorrhagic state. Warner, Brinkhous and Smith[2] have shown in dogs with a biliary fistula of long duration that after a blood transfusion there is a temporary rise in plasma prothrombin with a cessation of bleeding.

The purpose of this report is to demonstrate in dogs that it is possible to determine quantitatively the prothrombin change which occurs following transfusion and that the change is purely one of summation.

The animals used as recipients were of 3 types: 2 animals were normal dogs, 2 were dogs with obstructive jaundice, and one was a dog with a cholecyst-nephrostomy.[3] Normal dogs were used as donor animals. Plasma volumes before transfusion were determined by the vital red method.[4] The plasma volume after transfusion was calculated by addition of the volume of transfused plasma to the pre-

* This study was carried out under a grant from the John and Mary R. Markle Foundation.

1 Judd, E. S., Snell, A. M., and Hoerner, M. T., *J. Am. Med. Assn.*, 1935, **105**, 1653.

2 Smith, H. P., Warner, E. D., Brinkhous, K. M., and Seegers, W. H., *J. Exp. Med.*, 1938, **67**, 911.

3 Kapsinow, R., Engle, L. P., and Harvey, S. C., *S. G. and O.*, 1924, **39**, 62.

4 Rowntree, L. G., and Brown, G. E., *The Volume of the Blood and Plasma*, W. B. Saunders Company, 1929.

TABLE I.

Recipient				Donor					
Dog No.	Plasma vol., cc	Prothromb. units, per cc	Total units	Vol. transfused plasma, cc	Prothromb. units, per cc	Total units transfused plasma	Expected Total prothromb. units	Actual Total prothromb. units	% difference
1. P-1	386	30	11580	69	74	5106	16686	17745	+6.3
2. P-2	300	65	19500	69	89	6141	25641	24354	—5.0
3. P-1	430	75	32250	75	89	6675	38925	38885	—0.1
4. P-15	715	106	75790	78	108	8424	84214	81679	—3.0
5. P-10	860	39	33540	95	100	9500	43040	44862	+4.2
6. P-15	850	72	61200	94	116	10940	72104	66080	—8.4
7. P-17	925	64	59200	115	107	12305	71505	69160	—3.3

transfusion value. Prothrombin units before and 3 hours after the transfusion were determined by the method of Warner, Brinkhous and Smith.[5] All transfusions were performed by the indirect method, using sodium citrate as the anticoagulant.

The experiments in Table I show the effect of transfusions of citrated blood. Within the limits of experimental error, the actual total prothrombin content of the plasma of the recipient determined three hours after transfusion corresponds closely with the expected total. The error varies from plus 6.3% to minus 8.4% with an average of minus 1.3%. This indicates that the prothrombin in the plasma of the donor is distributed throughout the plasma of the recipient and can be detected quantitatively in the latter 3 hours after the transfusion. It further indicates that the change following transfusion is simply one of summation.

In vitro tests were also carried out. Blood was drawn from a normal dog and from a deficient dog. The plasma prothrombin content was determined in the 2 samples of blood and in differing mixtures of the two. For example, .8 cc of plasma having a prothrombin content of 107 units per cc was mixed with .2 cc of plasma having a prothrombin content of 25 units per cc. The expected prothrombin units of the 1 cc of mixed plasma would therefore total 91 units. Actually, the mixture when tested showed 99 units, a percentage difference of 9%. Various mixtures of the above plasma and of other plasmas treated in the same way showed percentage differences which ranged from minus 29% to plus 15%.

Summary. The changes in the total content of prothrombin in the plasma of a recipient after a transfusion are dependent on the prothrombin content of the plasma of the donor, and may be calculated on the basis of addition.

[5] Warner, E. D., Brinkhous, K. M., and Smith, H. P., *Am. J. Physiol.*, 1936, **114**, 667.