TABLE II. Effect of Normal Serum with and without Properdin on Functional Activity of Granulocytes in Shock Plasma.

N.P. added to S.P.		Phagocytic index (Mean of 4 exp.)	Bacteriostatic index (Mean of 4 exp.)
.00	.2	15 ± 3	24 ± 7
.01	.19	15 ± 3	29 ± 8
.02	.18	18 ± 6	31 ± 14
.04	.16	27 ± 3	31 ± 14
.08	.12	39 ± 8	43 ± 15
.16	.04	44 ± 8	68 ± 19
.20	.00	49 ± 7	68 ± 12
N.P. + P. added to	S.P.	Phagocytic index (Mean of 4 exp.)	Bacteriostatic index (Mean of 4 exp.)
.00	.2	15 ± 3	24 ± 7
.01	.19	16 ± 4	31 ± 9
.02	.18	21 ± 2	33 ± 8
.04	.16	31 ± 8	51 ± 9
.08	.12	39 ± 5	73 ± 8
.16	.04	45 ± 8	69 ± 9
.20	.00	49 ± 7	68 ± 12

of normal or shocked animals.

We are grateful to Dr. Louis Pillemer for the Properdin, which was stored at -20°C until immediately before use.

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Received March 27, 1957. P.S.E.B.M., 1957, v95.

Failure to Transmit Radiation-Induced Early Hypotension in Rabbits Connected Through Controlled Cross-Transfusion.* (23247)

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In rabbits, whole-body x-irradiation with doses above 50 r induces a blood pressure fall that becomes evident within 2 hours after exposure(1,2). Some experimental findings suggest that a similar hypotensive reaction may occur in a normal test animal after injection of blood originating from an irradiated rabbit(1). Is the blood pressure drop really caused by a blood-borne chemical factor? A decisive answer may be expected from continuous cross-transfusion studies. This type of experiment requires a high rate of blood exchange throughout a period of several hours, and conservation of a stable mean blood volume in each of the connected animals, even though a difference in blood pressure may develop. The present report describes a blood pump that fulfills the requirements and some results obtained with the equipment.

Methods. General procedure. With the arrangement depicted in Fig. 1, cross-transfusion was started at 30 min prior to irradiation, continued throughout the exposure time of 30 min. and concluded approximately 3 hours after irradiation. Then the blood volume of each rabbit was determined by the Evans blue method and the body weight remeasured. During transfusion the sequence of events was as follows: (I) withdrawal of blood from first animal, (II) change of valve position, (III) injection into second animal, (IV) withdrawal of blood from second animal, (V) change of valve position, (VI) injection into first animal; thereafter the next cycle started again with (I). In the present experiments motor speed was so regulated as to furnish three complete cycles every minute. Dead space in polyethylene tubing and valve amounted to 1/40 cc; therefore, a stroke vol-

* The author is indebted to H. A. Jaeger who constructed the cross-transfusion pump in the USAF School of Aviation Medicine.

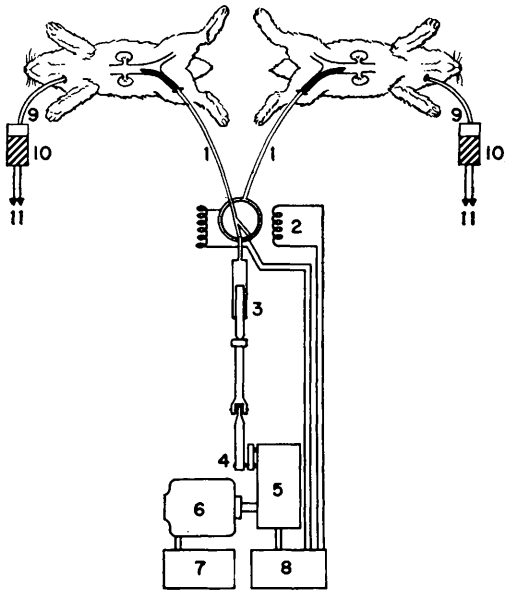

FIG. 1. Schematic drawing of experimental arrangement, the numbered sections of which represent: (1) polyethylene catheters introduced through femoral arteries, the tips are located in lower abdominal aorta halfway between iliac bifurcation and origin of renal arteries; (2) nylon valve with 2 rotary relays controlling its position; (3) 2 cc Luer syringe; (4) crank with adjustment for stroke volume of syringe; (5) box containing 853:6 gear ratio and 2 micro-switches operated by cams that are driven by the gear assembly; (6) 1/15-horsepower motor; (7) speed regulator for motor; (8) power supply box containing rectifier and 2 relays that, when triggered by the micro-switches in (5), energize the rotary relays in (2) and, thereby, control valve position; (9) polyethylene tubings in carotid arteries; (10) strain gauge for blood pressure recording; (11) connections to Heiland oscillograph recorder.

ume of slightly more than 2 cc yielded an effective volume of 2 cc, or an exchange rate of 6 cc/min/animal. For each rabbit the amount (c) of own blood in percent of its blood volume (v), as a function of the number (n) of pump cycles performed with an effective displacement (s), could be calculated from the equation $c = 50\left(1 + e^{-\frac{2sn}{v+s}}\right)$. Under the present experimental conditions (s, 2 cc; v, approximately 160 cc; and n, 3/min) a 55/45 mixture of bloods was reached within 30 min.

Irradiation. One animal of each pair was well shielded by a lead cover, while the other partner received whole-body x-irradiation under the following conditions: 260 kvp, 18 ma; inherent filtration, 0.25 mm copper; additional filtration, 1 mm aluminum and 0.5 mm copper; half-value layer, 1.4 mm copper; dose rate, 30 r/min.; exposure time, 30 min.; and total dose at center of animal, approximately 900 r, as measured in air with a Victoreen ionization chamber.

Results. Ten final experiments yielded uniform and convincing results. In all instances the procedure was well tolerated. Even after 5 hours of continuous cross-transfusion, hemolysis could not be detected and the difference in body weights between the two partners did not exceed initial value by more than 10 g, indicating a shift in blood volume of less than 10 cc. The shielded partners revealed blood pressure records that corresponded essentially to those obtained from nonirradiated single control animals. Thus it must be concluded that a damaging chemical factor, if existing in the blood of the irradiated rabbit, was not transferred in concentration sufficient to depress pressure in the nonirradiated partner. The irradiated animals showed tracings that corresponded closely to those obtained from single rabbits exposed to the same dose. All exhibited a pressure fall, reaching critical values within 1 to 2 hours following start of exposure (Fig. 2). Time course, degree, and final outcome of the hypotensive reaction seemed to be alike for cross-transfused and single rabbits. Thus it must be concluded that a beneficial chemical

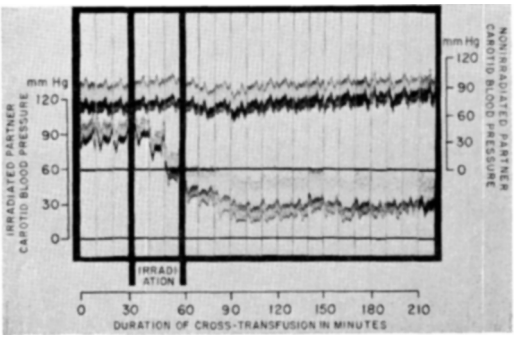

FIG. 2. Sections, covering 1 min. each, cut at 10-min. intervals from continuous carotid blood pressure records of 2 rabbits connected through cross-transfusion. During the 30 min., represented by the 3 sections between the two heavy bars, the animal of the lower tracing received 900 r whole-body x-irradiation, while that of the upper tracing was well shielded.

factor, if existing in the blood of the non-irradiated animal, was not transferred in concentration sufficient to ameliorate the pressure drop in the irradiated partner.

Discussion. Results of the present experiments leave no doubt that irradiated and non-irradiated rabbits connected through cross-transfusion behave like independent animals so far as blood pressure is concerned. Although absence of a vaso-depressive factor in the arterial blood does not exclude its existence at the tissue level and or in the venous blood, the findings point to the nervous system as an important participant in the early hypotensive reaction. This view is supported by the facts that atropinization and vagotomy strongly reduce the initial blood pressure response in rabbits(1,3), and that doses between 1500 and 2500 r cause hypotension in normal but not in spinal rats(4).

Summary. A pump for continuous cross-transfusion has been developed, and some studies about the nature of the early blood pressure fall induced in rabbits by x-irradiation have been conducted. Results of the cross-transfusion experiments indicate that the shielded animal does not protect its partner exposed to 900 r, neither does the irradiated rabbit affect the blood pressure of the shielded partner.

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Received March 29, 1957. P.S.E.B.M., 1957, v95.

Method for Temporary Exclusion of Liver in Dogs.* (23248)

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The major causes of the mortality associated with a one-stage hepatectomy in dogs are hemorrhage and air embolization. Leveen and Lewis(1), by substituting a plasticized vinyl tubing for the glass cannula originally described by Markowitz(2), greatly increased the number of surgical survivals. The liver is a unique organ in at least two respects. First, it has a double blood supply, the hepatic artery and portal vein. Occlusion of the latter results in rapid death, because the inflow of blood into the intestinal area has no return outlet to the general circulation. This loss of effective circulating volume results in irreversible shock. The liver is also unusual in dogs in that it drains directly into the vena cava without benefit of intervening blood vessels. In order to perform a successful total hepatectomy, therefore, the portal blood must be short-circuited into the vena caval (systemic) system, and a method must be utilized to block the venous outflow from the liver without occluding the vena cava.

Method. By reference to the diagram (Fig. 1) one can see how both these problems are met rather simply by the plastic cannula. A portal-caval anastomosis is established merely by insertion of the side arm of the tube into the distal divided portal vein. The hepatic venous drainage is trapped or occluded between ligatures A and B, while the systemic circulation can proceed unimpeded by the vena cava through the central portion of the tube. If the arterial supply is satisfactorily controlled the liver can now be removed with minimal blood loss and no compromise or block of the animal's circulation. If one desires, however, to reverse the hepatectomy 2 modifications are necessary. The artery must be occluded by means of a

* Supported in part by grant from U.S.P.H.S.