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Bleeding Volume in Experimental Colon Bacillus Intoxication.

PAUL H. HARMON AND HENRY N. HARKINS. (Introduced by Edmund Andrews.)

From the Department of Surgery, University of Chicago.

The present investigation is an inquiry into the mechanism of the profound drop in blood pressure that follows the intravenous administration of bacterial-free filtrates of the colon bacillus *(Escherichia coli)*. Zinsser, Parker and Kuttner[1] and others[2, 3] demonstrated that this organism produced a soluble and filtrable toxic substance that caused death after an incubation period when injected intravenously. Harmon and Harkins[4] showed that a profound but delayed drop in blood pressure to a shock level occurred in dogs receiving bacterial-free filtrates by the venous route.

Roome, Keith and Phemister[5] pointed out that a low bleeding volume characterized secondary shock where irretrievable loss of plasma or whole blood from the vascular system occurred as in trauma to an extremity, hemorrhage, plasmapheresis and following intestinal manipulation, while primary shock as induced by hyperventilation, anaphylaxis, histamine administration, spinal cord section and spinal anesthesia was accompanied by a higher bleeding volume. Harkins pointed out that the shock that accompanies severe experimental burns[6] and freezing[7] is a secondary type of shock accompanied by a loss of fluid into the injured tissues resembling blood plasma. This same author demonstrated that the bleeding volume of animals in shock due to experimental burns[8] and to freezing[9] was low (averaging 20.3 and 34.5% of the calculated blood volume, respectively).

Bacteria-free filtrates of 7-day cultures of 4 strains of colon bacillus, grown in peptone-free veal infusion broth were prepared by

1 Zinsser, H., Parker, J. T., and Kuttner, A., PROC. SOC. EXP. BIOL. AND MED., 1920, **18**, 49.

2 Branham, S. E., *J. Infect. Dis.*, 1925, **37**, 538.

3 Steinberg, B., and Ecker, E. E., *J. Exp. Med.*, 1926, **43**, 443.

4 Harmon, P. H., and Harkins, H. N., PROC. SOC. EXP. BIOL. AND MED., 1934, **32**, 6.

5 Roome, N. W., Keith, W. S., and Phemister, D. B., *Surg. Gynec. and Obstet.*, 1933, **56**, 161.

6 Harkins, H. N., PROC. SOC. EXP. BIOL. AND MED., 1934, **31**, 994.

7 Harkins, H. N., PROC. SOC. EXP. BIOL. AND MED., 1934, **32**, 432, 434.

8 Harkins, H. N., PROC. SOC. EXP. BIOL. AND MED., 1934, **32**, 3.

9 Harkins, H. N., PROC. SOC. EXP. BIOL. AND MED., 1935, **32**, 000

TABLE I.

Terminal Bleeding Volume: Associated Changes in Blood Pressure, Cell Volume, and Hemoglobin Following the Intravenous Injection of Colon Bacillus Filtrates.

Dog No.	Wt. Kg.	Cc. of Berkefeld filtrate intraven.	Time from inj. to death by bleeding (Hr.)	Blood Pressure mm. of Hg. Initial	Blood Pressure mm. of Hg. Prior to Bleeding	Hemoglobin, % Initial	Hemoglobin, % Prior to Bleeding	Hematocrit Initial	Hematocrit Prior to Bleeding	Terminal bleeding volume. % calc. blood vol.
1P	6	50 cc. *B. coli* Communis (Sw)	2.0	166	42	84	94	38	45	43
3P	7.5	50 cc. *B. coli* Communior (Di)	2.25	124	36	100	122	45	58	33
4P	5.0	50 cc. *B. coli* Communis (Ja)	8.25	164	40	91	105	46	50	61
5P	8.8	40 cc. *B. coli* Communior (La)	2.0	164	66	104	106	45	45	35
		Average								43

filtration through Berkefeld-N filters. Dogs from 5.0 to 8.8 kg. received a quantity of filtrate intravenously (Table I), after being under full anesthesia induced by barbital (275 mg. per kilo body weight). Blood pressure was recorded by the direct method from the carotid artery through a mercury manometer. Observations were made upon the percentage of hemoglobin (Sahli: 17 gm. per 100 cc. = 100%) and of the volume per cent of red cells with the Van Allen hematocrit both prior to injection of the filtrates and at intervals following intravenous injections. When the blood pressure declined to the shock level the bleeding volume was obtained by measuring the total volume of blood that escaped from the carotid artery with the animal tipped cephalad 15 degrees from the horizontal.

Results. Although the blood pressure dropped rapidly to the so-called shock level, there was but a minor degree of concentration of the blood as evidenced by only a slight rise in the percentage of hemoglobin in the circulating blood and in the hematocrit reading. The average bleeding volume in these experiments was 43% of the calculated blood volume. Although this result is lower than the average bleeding volume of 58.6% as found by Roome, Keith and Phemister[5] and of 53.4% as determined by Harkins,[8] it is definitely high enough to allow this type of shock to be classified as primary shock.

Conclusions. The shock state that follows intravenous injection of bacteria-free filtrates from the colon bacillus is classed as primary shock since the bleeding volume approximates that of the control animals.