TABLE I.
Rats Infected with *Trichinella spiralis* and Treated with Sulfanilamide.

Group	No. of rats	No. of larvæ fed	Treatment with sulfanilamide	Avg No. of larvæ in muscles
Experiment 1				
Treated	4	2,000	125 mg for 12 days beginning the 6th day after infection	110,900
"	4	2,000	125 mg for 16 days beginning the day after infection	99,800
Control	8	2,000	None	93,200
Experiment 2				
Treated	9	3,000	125 mg for 12 days beginning the day after infection	165,600
Control	8	3,000	None	236,600

mately the same in the treated rats as in the control animals (Table I). In other treated rats (not listed in the table), killed at intervals after the beginning of treatment, no lethal effect was observed either on the adult worms in the intestine or on the developing larvae in the muscles. Also, as judged by the amount of weight lost during the course of the infection, the drug had no effect on the severity of the symptoms. In fact, the treated rats lost considerably more weight than the control animals, and also more than other rats which were given the same amount of drug but were not infected with *Trichinella*. No evidence was found to suggest, therefore, that sulfanilamide had any value in the treatment of experimental trichiniasis in rats.

9896

Human Ascitic Fluid as a Blood Substitute in Experimental Secondary Shock.

H. A. DAVIS AND C. S. WHITE. (Introduced by Paul W. Smith.)
From the Department of Pathology, University of Tennessee, and Department of Surgery, George Washington University.

The value of a substitute for whole blood for clinical and experimental use is self-evident. Various solutions have been utilized, such as blood plasma,[1, 2] gum-saline,[3, 4] gelatin-saline,[5, 6] hemoglobin-

[1] Guthrie, C. C., and Pike, F. H., *Am. J. Physiol.*, 1907, **18**, 14.

[2] Richet, C., and Brodin, P., *Compt. Rend. Acad. Sci.*, 1917, **167**, 55.

[3] Morawitz, P., *Beitr. Chem. Physiol. Path.*, 1906, **7**, 153.

[4] Robertson, O. H., and Bock, A. B., *Rep. Med. Res. Council, Lond.*, 1918, No. 25, 213.

[5] Hogan, J. J., *J. A. M. A.*, 1915, **64**, 721.

[6] Clark, G. W., *J. Immunol.*, 1918, **3**, 147.

Ringer's solution,[7] and whole blood obtained from the placenta,[8] umbilical cord,[9] and cadaver.[10] In this study we have endeavored to determine the effectiveness of human peritoneal and pleural transudates as substitutes for blood in experimental hemorrhagic shock. In most of these experiments ascitic fluid (peritoneal transudate) was used. This was obtained from human patients suffering from cardiac decompensation, or from portal cirrhosis of the liver. The fluids were removed with aseptic precautions and filtered through fine gauze. Each fluid was submitted to the following examinations: Kahn test, blood agar culture and chemical determination of the protein and electrolyte content. The fluids were stored at a temperature of 0C to 5C for varying periods up to 5 months. No preservatives were used and bacteriological examinations were made at intervals using the blood-agar plate method. It was found that such fluids could be kept sterile for long periods, and that prolonged refrigeration did not affect their efficiency as substitutes for blood.

Chemical Composition. In a series of ascitic fluids, quantitative chemical examination revealed the following figures per 100 cc: total protein, 2.0 to 3.19 g; albumin, 0.96 to 1.9 g; globulin, 0.6 to 0.8 g; fibrinogen, 0.2 to 0.41 g; non-protein nitrogen, 18 to 40 mg; sodium chloride, 700 to 750 mg; and calcium, 6.8 to 7.8 mg. The albumin: globulin ratio varied from 1.1:1 to 2.3:1 (Table I). It has been pointed out that group specific agglutinins are present in peritoneal and pleural transudates,[11-13] and that such substances are similar to those occurring in blood serum. Similarly, group specific substances are present in the lower animals, *e.g.*, in dogs.[14, 15] In view of these facts, the compatibility of the fluid with the blood of the prospective recipient was carefully determined. In each instance a cross-matching test was performed.

A series of 15 dogs, weighing from 7-10 kg, was used. Nembutal anesthesia was induced and shock was produced by graded hemorrhage. The criterion of shock was a systolic blood pressure

7 Amberson, W. R., and Höber, R., *J. Cell. Comp. Physiol.*, 1932, **2**, 201.

8 Malinovskij, M. S., Smirnova, L. G., Boyarshinova, M. S., and Tarzanova, V. G., *Sovet. Khir.*, 1934, **7**, 179.

9 Novikova, L. A., and Farberova, R. S., *Sovet. Khir.*, 1936, No. 11, 794.

10 Yudin, S. S., *Lancet*, 1937, **2**, 361.

11 Weil, P., and Isch-Wall, P., *Comp. Rend. Soc. de Biol.*, 1923, **88**, 173.

12 Yosida, K. I., *Z. f. d. ges. exp. Med.*, 1928, **63**, 331.

13 Schiff, F., *Uber die gruppenspezifischen Substanzen des menschlichen Körpers*, pp. 71, Fischer, Jena, 1931.

14 von Dungern, E., and Hirschfeld, L., *Z. f. Immunitäts. u. exp. Therap.*, 1911, **8**, 526.

15 Thomsen, O., and Kemp, T., *Z. f. Immunitäts. u. exp. Therap.*, 1930, **67**, 251.

TABLE I.
Composition of Human Ascitic Fluid.

No.	Condition	Kahn Reaction	N.P.N. mg per 100 cc	Fibrinogen g per 100 cc	Albumin g per 100 cc	Globulin g per 100 cc	A/G Ratio	Total Protein g per 100 cc	NaCl mg per 100 cc	Ca mg per 100 cc
7	Portal Cirrhosis	Neg.	22	.2	0.96	.84	1.1:1	2.0	750	7.8
10	,, ,,	,,	40	.41	1.9	.88	2.1:1	3.19	700	7
12	,, ,,	,,	18	.3	1.4	.6	2.3:1	2.3	750	6.8

TABLE II.
Influence of Ascitic Fluid in Hemorrhagic Shock.

Dog No.	Wt, kg	Calculated blood vol., cc	Amt of blood removed	Blood removed expressed as % of body wt	Amt of ascitic fluid, cc	Blood pressure mm Hg			Results
						Before hemorrhage	After hemorrhage	After ascitic fluid administered	
C-6	7.4	666	250	3.4	500	144	55	120	Survival
G-4	9.6	864	380	3.9	550	170	64	128	,,
B-5	8.2	738	350	4.2	520	135	50	110	,,

of 60 mm Hg or less. Kymographic tracings of the blood pressure were made in the usual manner from the carotid artery. Ascitic fluid warmed to 33C was allowed to flow into the femoral vein at a rate of 15 cc per minute. The infusion was commenced as soon as the blood pressure had maintained a constant level for a period of 3 to 5 minutes. Chemical examinations of the urine were made daily following each experiment for a period of 3 weeks. A control series of 10 normal animals was utilized.

In mild and moderately severe secondary shock, the infusion of human ascitic fluid was efficacious in raising and maintaining the systolic blood pressure well above the shock level. The elevation of the systolic blood pressure was gradual and usually reached a total of 50-60 mm Hg above the shock level. Not infrequently, there occurred a slight drop of blood pressure upon cessation of the infusion, but subsequently a return to the initial level took place. During the infusion, the respirations, which were rapid and shallow during the period of shock, became deeper and slower. It was found that the optimum amount of fluid varied with each animal, but did not exceed the calculated normal blood volume of the individual dog. The animals survived indefinitely, and revealed no immediate or delayed effects from the infusion. Examination of the urine showed a complete absence of albuminuria, glycosuria and haematuria. Apparently, the kidneys did not sustain any injurious effects from the ascitic fluid. Moreover, the consistent absence of albuminuria suggests that the proteins of the fluid are utilized by the animal. Representative data are presented in Table II. Injection of ascitic fluid into the control animals produced a rise of blood pressure of 15 to 30 mm Hg above the initial level, and a return to normal within twenty minutes.

These studies indicate that human ascitic fluid is of value as a substitute for whole blood. It possesses certain advantages; prolonged storage without preservatives does not affect its physiological availability in the organism; it is a fluid containing human proteins; it costs nothing; a constant source of supply is present in every hospital in patients suffering from various forms of chronic cardiac decompensation or from portal cirrhosis of the liver; it is sterile; its use obviates the dangers attending the use of proteinless infusions in secondary shock.[16]

Conclusion. Human ascitic fluid, when administered to group-compatible recipients, is capable of raising and maintaining the blood pressure in secondary shock.

[16] Davis, H. A., *Arch. Surg.*, 1937, **35**, 461.