Host Resistance to Bacteria in Hemorrhagic Shock IV. Effect of Hypothermia on Clearance of Intravenously Injected Bacteria.* (22207)

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Dogs recover if transfused after exposure to severe hemorrhagic shock of 2 hours duration(1). But they die if given an intravenous dose of bacteria which a normal dog readily destroys(2). This is true whether the bacteria are given during the two hour period of shock or anytime within the next 24 hours. This is evidence that hemorrhagic shock impairs the bactericidal mechanisms. In this report we present evidence that precooling the animal to be subjected to hemorrhagic shock protects the bactericidal mechanisms.

Method. Healthy mongrel dogs, weighing 15-22 kg were premedicated with morphine (2 mg/kg), and then immersed in iced water under light ether anesthesia until the rectal temperature reached 28°C. After a short interval for desaturation of the ether, the dogs were removed from the iced water and put into hemorrhagic shock by the elevated reservoir technic(3). No anesthesia was required thereafter to maintain the hypothermia. During the hypotensive period the rectal temperature ranged between 28° and 23°C. In the occasional instance in which it fell below 23°C warm water bags were applied. After 2 hours in shock the shed blood was returned by slow venous infusion, during which the dog was immersed in warm water until the rectal temperature reached 37°C. 5-50 billion *E. coli* or hemolytic coagulase-positive staphylococci (24 hour culture) were given intravenously either during the period of hypotension (Group IV, Table I) or after transfusion and warming to normal body temperature (Group V, Table I). In addition to these experiments, concurrent experiments were performed to test the response of normothermic dogs, transfused after exposure to 2 hours of shock, to the same bacterial suspensions. The animals were observed until death or full recovery.

Results. These are given in Table I. The data of Groups I to III are taken from the published report of the previous work in normothermic dogs referred to above(2). The additional experiments like those in Group III, performed concurrent with those in Groups IV and V, resulted in death in every instance.

In contrast to a zero survival rate for normothermic shocked dogs challenged with bacteria, the precooled shocked dogs (Groups IV and V) challenged the same way show a survival rate of 75% or better.

Normal dogs (Group I) show negative blood cultures 24 hours after injection of the bacteria, and the tissues are sterile within 48 hours. All dogs in Group III show a bacteremia at this time and until death, which occurs within 1-4 days. Of the survivors in Groups IV and V half showed positive blood cultures after 24 hours, but all showed negative blood cultures after 48 hours. All dogs which died in Groups IV and V showed positive blood cultures until death.

Discussion. From the Group IV experiments, in which bacteria were injected during hypothermia, one could attribute the result to some degree to the suppression of bacterial activity by the hypothermia. But the Group V experiments demonstrate that whether this is so or not, the antibacterial defense is sufficiently preserved by the hypothermia to enable the dog to cope with a dose of bacteria, injected after the body temperature is back to normal, which the uncooled dog cannot withstand.

In a forthcoming publication(4) further data are offered showing that the protection conferred on the anti-bacterial defense mechanisms by this degree and duration of hypothermia, though considerable, is not suf-

* Supported by a contract with the Office of the Surgeon General, U. S. Army, through Subcommittee on Shock of the National Research Council.

TABLE I. Effect of Hypothermia upon Resistance to Bacteria Given during or after Shock of 2 Hours Duration.*

Group	Experiment	No. of dogs	Survivors No.	Survivors %
I	*E. coli* intravenously in normal dogs	10	10	100
II	2 hr shock in normothermic dogs	10	9	90
III	2 hr shock in normothermic dogs, and *E. coli* intrav. during shock or up to 24 hr after transfusion	30	0	0
IV	Hypothermia (28°C) induced prior to 2 hr shock, *E. coli* intrav. during hypotensive period—warmed to normal temp. after transfusion	8	6	75
V	Same as Group IV except *E. coli* given after body temp. was back to normal†	14	11	79

* Hemorrhagic shock—bleeding to blood pressure 30 mm Hg for 2 hr followed by transfusion of all shed blood.

† This group includes 4 experiments in which a coagulase-positive hemolytic *Staphylococcus aureus* was used. Recovery rate is about the same for this organism as for *E. coli* in normothermic and hypothermic dogs.

ficient to fully sustain their original potency.

Conclusion. The anti-bacterial defense mechanisms of the dog, which are severely injured by exposure to hemorrhagic shock of two hours duration, are protected to a considerable degree by precooling to 28°C.

1. Schweinburg, F. B., Frank, H. A., and Fine, J., *Am. J. Physiol.*, 1954, v179, 532.

2. Jacob, S., *et al., ibid.*, 1954, v179, 523.

3. Fine, J., *et al., Bull. N. Y. Acad. Sci.*, 1952, v55, 429.

4. Friedman, E. W., Davidoff, D., and Fine, J., *Am. J. Physiol.*, in press.

Received November 7, 1955. P.S.E.B.M., 1956, v91.

Fluorine in Urinary Tract Calculi.*† (22208)

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The pathogenesis of urolithiasis is one of the unsolved problems in modern medicine. A recent survey answered by 340 American urologists showed an average recurrence rate of 13.7%(1). It is apparent that urinary tract calculi form an important disease entity and that any new facts which may help clarify the problem of calculogenesis are worthy of attention.

The purpose of this note is to report that fluorine has been found in urinary calculi with frequency. Searching the literature failed to reveal reports of urinary calculi analyzed for fluorine. It has been reported that renal damage, albuminuria and hematuria have been found in humans and animals suffering from fluorine poisoning(7-13).

Methods. Parts of the stones from 10 cases of urolithiasis were analyzed for calcium, ammonium, magnesium, oxalates, phosphates, urates and carbonates in our laboratories. Other parts were analyzed for fluorine by the laboratories of Dr. H. Amphlett Williams of London, England, and Dr. Chester A. Snell of Foster D. Snell, Inc., N. Y. City. Determination of fluorine in such materials is a difficult, delicate and tedious laboratory procedure accomplished by different methods by each individual. The method used by Dr. Williams is that described by him in 1946(2). Dr. Chester Snell states(3) that his methods in determining fluorine content of calculi were those mentioned in the "Official Methods of Analysis

* Supported by grants from: Charles Rose, Scheuer Associates Foundation, S. H. and Helen R. Scheuer Family Foundation.

† The aid of Dr. M. L. Gottlieb for making available data from his service and that of Dr. A. S. Goldberg for supplying analytic data is gratefully acknowledged.