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Temperature Changes in Skin and Muscle of Lower Extremities Following Intravenous Injections of Typhoid Vaccine.*

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(Introduced by G. Shwartzman.)

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Intravenous injections of typhoid vaccine have been used extensively in the treatment of peripheral vascular diseases.[1-4] Since our previous studies showed that the temperature of the skin and muscles of the lower extremities is not altered in a parallel manner by certain other procedures, a study of the effect produced by typhoid vaccine on these 2 structures seemed desirable. This study was limited to the changes noted in the calf muscles and skin of the feet. The range of fever employed was from 99 to 101°F, since higher temperatures are usually avoided in the treatment of peripheral vascular diseases.

The initial intravenous dose of typhoid vaccine was five million microörganisms. In some individuals this amount was inadequate to produce any reaction and it was progressively increased until the systemic temperature was raised 2 or 3°F. The temperatures of the skin surface and calf muscles were observed independently. Thermocouple needles were inserted into the calf muscles and preliminary temperature stabilization was obtained in each case. All skin surface temperature readings were made on the plantar surface of the distal phalanx of the great toe. The skin surface and calf muscle temperatures were recorded at 10-minute intervals for a period of 2½ to 5 hours after the reaction. The rectal temperature was obtained by means of an automatic registering resistance rectal thermometer. The reaction usually occurred from 60 to 90 minutes after the injection. Most of the patients complained of feeling a little cooler for a period of from 15 to 20 minutes but had no marked chills. In some the chills and tremors were violent.

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1 Goodman, C., and Gottesman, J., *N. Y. Med. J.*, 1923, **117**, 774.

2 Brown, G. E., Allen, E. V., and Mahorner, H. R., *Thrombo-Angiitis Obliterans*, W. B. Saunders Co., Philadelphia, 1928, p. 143.

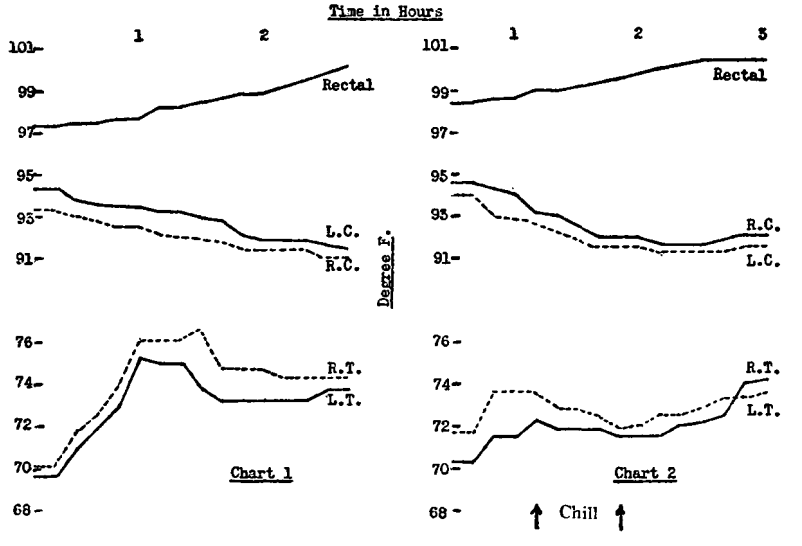
3 DeTakats, G., and Mackensie, W. D., *Surg., Gyn. and Obst.*, 1934, **58**, 655.

4 Wright, Irving, S., *M. Clinic North America*, 1934, **17**, 1429.

Twenty-eight cases were studied in this manner. In the majority of cases a rise in systemic temperature began about an hour after the injection. The body temperature continued to rise gradually and was accompanied by a gradual fall in calf muscle temperature. The chill period usually occurred about 1½ hours after the injection. The rise in systemic temperature and fall in muscle temperature continued throughout this period. The rate of change did not vary regardless of whether or not muscle tremors took place. Following the chill, the gradual rise in body temperature and fall in muscle temperature continued. In some cases the skin surface temperature rose before the occurrence of the chill. In almost all cases it dropped at the onset of the chill and rose above the initial level after the tremors subsided.

To illustrate the fact that the reactions are essentially similar regardless of whether chills and tremors occur or not, 2 typical fever charts are shown.

The data obtained in these experiments permit certain conclusions. It is noted that during fever elicited by the intravenous injection of typhoid vaccine there occurs a gradual fall in the calf muscle temperature. The skin surface temperature increases. Differences in the temperature of tissues are indicative of variations in the blood supply to those structures. It would, therefore, appear that an elevation of the systemic temperature to 101°F is associated with an increase in the circulation of the skin of the feet and a decrease in the circulation of the calf muscles. Further investigations are being



carried on to determine the changes which occur in muscles of other parts of the body, of the effects produced by temperatures exceeding 101°F, and the changes which occur later than 5 hours after the reaction. It is also important to determine whether similar alterations develop in fevers of other types.

Since the calf muscle temperature was always several degrees lower than the systemic temperature and since it actually decreased during the production of fever, it appears that the increased body temperature under the conditions described cannot be attributed to any activity in the calf muscles. This was true in spite of evidence of markedly increased muscular activity during the chill period.

Since the circulation of the skin is improved during the reaction following the intravenous injection of typhoid vaccine, such injections may be beneficial in the treatment of ulcers. However, since the calf muscle circulation is not increased, the use of this method of treatment for relief of intermittent claudication appears to have no physiological basis.

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Reversibility of the *Alpha* and *Beta* Phases of *Salmonella typhi*.*

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By the cultivation of *Salmonella typhi* in broth containing antiserum derived from the specific phase of *Salmonella muenchen*, Kauffmann[1] was able to isolate a variant which possessed altered flagellar antigens and which was no longer agglutinable in *S. muenchen* antiserum. The variant was obtained from only one culture and was not reversible. It was designated as a *beta* phase of the theretofore supposedly monophasic typhoid bacillus. Through cultivation in immune serums, *beta* phases were also obtained by Kauffmann and Tesdal[2] from *Salmonella schleissheim* and by Gard[3] from *Salmonella abortus-canis*. None of these induced phases were reverted to the

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1 Kauffmann, F., *Z. f. Hyg.*, 1936, **119**, 103.

2 Kauffmann, F., and Tesdal, M., *Z. f. Hyg.*, 1937, **120**, 168.

3 Gard, S., *Z. f. Hyg.*, 1938, **121**, 139.