

COLD INJURY

TRANSACTIONS OF THE FOURTH CONFERENCE

NOVEMBER 7, 8 AND 9, 1955

CONTENTS

Follow-up of Cold Injury Cases from the Korean War

Roentgenologic Changes in Bones

Experimental Cold Injury in the Rabbit

Roentgenologic Changes in Frostbitten Rabbits

Histopathologic Studies in Frostbitten Rabbits

**Cellular Metabolism Following Experimental
Cold Injury**

Experimental Immersion Foot in the Rabbit

Follow-up of Cold Injury Cases from World War II

**Resuscitation of Hypothermic, Supercooled
and Frozen Mammals**

**Protective Measures Against Ventricular
Fibrillation During Hypothermia**

Hypothermia During Open Heart Surgery

**Cerebral Studies During Local and
General Hypothermia**

EDITOR

M. IRENÉ FERRER

THE JOSIAH MACY, JR. FOUNDATION

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Transactions of the Fourth Conference
November 7, 8, and 9, 1955, Princeton, N. J.

Edited by

M. IRENÉ FERRER, M.D.

ASSISTANT PROFESSOR OF CLINICAL MEDICINE
DEPARTMENT OF MEDICINE, COLUMBIA UNIVERSITY
COLLEGE OF PHYSICIANS AND SURGEONS
NEW YORK, N. Y.

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THE JOSIAH MACY, JR. FOUNDATION CONFERENCE PROGRAM

DURING THE PAST FIFTEEN YEARS the Josiah Macy, Jr. Foundation has organized more than twenty conference groups, each group meeting for at least two days annually over a period of five or more years. Each meeting is limited to twenty-five participants (members and guests), selected to represent a multidiscipline approach to some urgent problem in the field of medicine and health. The goal of this conference program is the promotion of communication, the exchange of ideas, and the stimulation of creativity among the participants. The publication of the Transactions of the meeting is undertaken to share, as far as possible, the conference process with a larger audience than could participate personally in the discussions.

These conferences provide an opportunity for informal give and take among the participants. To further this purpose the number of presentations planned for each day is generally restricted to one or two. The member, or guest, selected to give such a presentation is requested not to "read a paper," but rather to highlight, in an informal manner, some of the more interesting aspects of his or her research, with the expectation that there will be frequent interruptions by participants in the form of questions, criticism, or comment. Such interruptions during the course of a presentation are encouraged and form an essential part of the "group interchange."

The conference program has always been viewed by the Foundation as an experiment in communication in which there is room for improvement and need for frequent reappraisal. Sufficient experience has already been gained to justify the conclusion that this type of conference is an effective way of improving understanding among scientists in medicine and allied disciplines, of broadening perspectives, of changing attitudes, and of overcoming prejudices. The further conclusion has been reached, as the result of this experiment, that the major obstructions to understanding among scientists lie in the resistance of human attitudes to change, rather than in difficulties of technical comprehension. Less extensive experience with non-scientists has indicated that the effectiveness of this type of conference is not limited to groups of scientists,

but will function in any group meeting where more effective communication is the primary goal. It is also clear that the same conference technique, with minor changes, is readily adapted to small international conferences.

The style of publication of the Transactions has aroused considerable interest and some criticism. The criticism has been directed primarily to editorial permissiveness which has allowed in the final test, in some instances, too many questions, remarks, or comments which, although perhaps useful during a heated discussion, seem out of context and interrupt the sequence of thought in the printed volume. A few have objected to the principle of publishing in this style and would prefer a depersonalized summary without interruptions.

The Foundation Staff and the Scientific Editors of these volumes welcome criticism and hope to profit thereby in increasing the usefulness of the Transactions to scientists and students of science in this country and abroad.

FRANK FREMONT-SMITH, M.D.,
Medical Director

FOLLOW-UP STUDY OF COLD INJURY CASES FROM THE KOREAN WAR*

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THOSE OF YOU WHO WERE PRESENT at the second conference in New York will recall that Lt. Col. Kenneth D. Orr and Comdr. Leonard M. Schuman (1) gave a very complete coverage of the epidemiology and the acute phases of cold injury as it was observed in Korea. A group of us at Harvard Medical School in Boston, through contracts with the Army Medical Service,* have continued these studies originally begun by Colonel Orr (2) and have just completed a follow-up study on these cases 4 years after injury.

The 100 cases on which we are going to present some data for your consideration and discussion are fairly representative of the approximately 5600 cases of cold injury that were evacuated from Korea during the winter of 1950-51. We were very fortunate that in these 100 cases we had very complete records, i.e., histories, physicals, physiologic measurements, photographs, laboratory studies, and roentgenograms, from shortly after occurrence of cold injury right on through channels of evacuation, periods of hospitalization, rehabilitation, and return to military duty or civilian life. The original study, in most cases, was carried out over a period of about 18 months. Since then these patients had not been restudied until our group at Harvard Medical School had the opportunity of doing so.

Table I reveals the degree of success we enjoyed in our follow-up study of the original 100 frostbite cases. Through the services of the Army Adjutant General and the Veterans Administration we were able to locate all 100 of these former patients. Letters were written requesting their voluntary participation in the follow-up study, completion of history forms and frostbite questionnaires,

*The work here reported was supported by Contract DA49-007-MD-342 between Harvard University and the Office of the Surgeon-General, Department of the Army.

The medical histories, clinical summaries, physiologic data, serial photographs, and serial roentgenograms used in this study have been indexed and filed in the library of the Army Medical Research Laboratory, Fort Knox, Kentucky, and are available to any interested students or investigators.

and that they report to Army and Veterans Administration hospitals for physical examination, photographs, and roentgenograms. Ninety-seven of the 100 patients volunteered to participate in the study. Three did not reply although it was established that our letters were received. Of the 97 who returned the completed questionnaires and histories, 89 actually reported to medical installations for physical examination, roentgenograms, and photographs. We were fortunate in being able to conduct personally the physical examinations and various studies on fifty of these patients. This number was limited by the fact that many of the patients lived in Hawaii and Puerto Rico, or were still in the Armed Forces on various overseas assignments.

TABLE I
Summary of Follow-Up Study of Cold Injury Patients
4 Years After Injury

| | |
|--|-----|
| No. patients in study | 100 |
| No. patients located | 100 |
| No. patients participating (answered mail questionnaires) | 97 |
| No. patients x-rayed | 89 |
| No. physical examinations (by the authors) | 50 |

The study was carried out by the following procedures: Our group drew up a set of history forms and frostbite questionnaires that were sent to the patients to be completed and returned. One question that has disturbed us greatly and to which we do not have a final answer is, how valid is the information derived from these questionnaires? Interpretation of the data must be made in light of two facts: (1) the frostbite questionnaires were completed by patients with no supervision or instructions other than that in the cover letter, and (2) approximately one-third of the patients are drawing disability compensation from the Veterans Administration which they are very anxious to protect and not give answers that may jeopardize it.

We have used three methods in trying to increase the accuracy of answers on the questionnaire: (1) We have placed in the questionnaires many questions asking the same thing but in different phraseology as a "cross-check" on the answers received. (2) When a questionnaire was returned with answers which did not agree with the severity of injury, previous history, or physical examination, a second and sometimes third questionnaire was sent to these individuals at intervals of several months. The various questionnaires were then cross-examined for accuracy and consistency of information supplied. (3) When we personally examined the fifty study patients the questionnaires were checked very carefully against physical examinations and medical histories. These procedures have greatly increased the accuracy of the data from the questionnaires, but the symptoms are still not consistent with organic physical findings. The symptoms are much more severe than organic lesions would indicate.

Table II gives some knowledge of the background and characteristics of the study group. The majority, or 85, were young males, from 17 to 25 years of age. They were about evenly distributed between whites and Negroes, with two Puerto Ricans, one Japanese-American and one Hawaiian in the group. They were all enlisted personnel, primarily in the three lower grades.

As to the site of the frostbite lesion in these 100 cases, Table III shows that it occurred in one or both feet in a total of 97 patients. The hand was frostbitten in 11 patients and in some cases both hands and feet were involved. This is about the same ratio observed in the 5600 patients evacuated from Korea; approximately 3 per cent had hand involvement only; 10 per cent had hands involved with or without the feet; and 97 per cent had involvement of feet.

As to the severity of the lesion, 69, or over two-thirds of the group, had a third degree cold injury; second degree, 10; and fourth degree, 19.

We have still another classification, the so-called "ill-defined condition of the feet."* This is a diagnosis for a foot condition that occurred frequently in Korea but which could not be established as a true frostbite lesion. First, the lesion was not localized as was the typical frostbite lesion; and secondly, it occurred frequently at

*"These patients showed hyperhidrosis of the feet with erythema, maceration and denudation of the plantar aspects. The feet were usually cool to touch. There was no numbness or hypesthesia. No diagnostic title applicable to this condition is present in the Joint Armed Forces Diagnostic Nomenclature Manual. Therefore, the descriptive title, 'Ill Classified Condition of the Feet Manifested by Hyperhidrosis, Erythema, Maceration and Coldness' was given" (2).

TABLE II
Distribution of Patients as to Age,
Race, and Rank

| Age | | Race | | Rank | |
|----------|-----|-------------------|-----|-------|-----|
| Years | No. | Race | No. | Grade | No. |
| 17 to 20 | 53 | White | 55 | Pvt. | 35 |
| 21 to 25 | 32 | Negro | 41 | Pfc. | 37 |
| 26 to 30 | 7 | Puerto Rican | 2 | Cpl. | 22 |
| 31 to 35 | 6 | Japanese-American | 1 | Sgt. | 5 |
| 36 to 40 | 2 | Hawaiian | 1 | Sfc. | 1 |

TABLE III
Site and Severity of Cold Injury Lesions

| Site of Lesion | Frostbite | | | Ill Defined Condition of the Feet | Total |
|----------------|-----------|----|----|-----------------------------------|-------|
| | 2° | 3° | 4° | | |
| One foot | 3 | 18 | 0 | 0 | 21 |
| Both feet | 4 | 47 | 15 | 2 | 68 |
| Hands | 0 | 0 | 3 | — | 3 |
| Hands and feet | 3 | 4 | 1 | — | 8 |
| Total | 10 | 69 | 19 | 2 | 100 |

temperatures well above freezing. It was characterized by erythema, hyperhidrosis and maceration, and it appeared quite similar to mild trench foot, but there was no numbness or hypesthesia.

Incidence of "ill-defined condition of the feet" was a little higher in Korea than in our study group; about 10 per cent or roughly 500 of the 5600 cases were diagnosed as "ill-defined condition of the feet." Only two of our 100 study patients had such a diagnosis.

Fremont-Smith: Did those who had genuine frostbite in one area of the extremity ever have the equivalent of "the ill-defined