—シンポジウム / 会合報告—
Symposium/Meeting Report

Report on Workshop on Antarctic Medical Research and Medicine 2006

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2006 年南極医学医療研究集会報告

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要旨：南極医学医療研究集会は，わが国の南極医学研究と医療問題についての研究成果を報告・討論し，次期の観測隊における医学研究に寄与することを目的として毎年行われている．2006 年の本研究集会は 8 月 26 日，国立極地研究所講堂で行われた．27 施設から 42 名が参加し 18 の演題報告がなされ，近年では最大規模の研究集会となった．

参加者は越冬経験医師をはじめ，共同研究を行っている大学や研究機関の研究者，関連領域の研究を行っている宇宙開発機構やスポーツ科学研究所などの研究者，南極に興味のある一般病院の臨床医など多彩であった．

2004 年より昭和基地に導入されたテレビ会議システムを活用して，昭和基地の医師もリアルタイム映像で討論に参加した．また韓国，中国の越冬医師が初めて参加した．これは 3 カ国の極地研究所による事前の準備と連携により実現した．集会では各国の南極基地の医療状況や医学研究活動が報告され，活発な意見交換がなされた．南極医学医療研究分野におけるアジア連携の端緒となることが期待される．

Abstract: A workshop on Antarctic Medical Research and Medicine 2006 was held at

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the National Institute of Polar Research (NIPR) on 26 August, 2006. Forty two participants from 27 institutes attended. The members consist of medical doctors with Antarctic experience, human biologists, research scientists in other fields, logistic staff members of the expedition and also medical doctors interested in Antarctica.

The current resident doctor at Syowa Station joined the discussion through a telecommunication system. Doctors with Antarctic experience from China and Korea also participated in the workshop. They gave presentations on their Antarctic activities, followed by an active discussion session.

Eighteen presentations were given on various topics, including the International Polar Year (IPY) 2007–2008 in medical research, space medicine, telemedicine, an international comparative study of medical operations, psychological surveys, Antarctic high-altitude medicine, Legionella surveillance and nutritional studies.

1. Summary

The Japanese Workshop on Antarctic Medical Research and Medicine is held every year. This workshop is organized by the Japan Antarctic Medical Research Group (JAMRG) as an NIPR project. The purpose of the workshop is to discuss issues related to Japanese Antarctic medicine and to propose projects for the next expedition's medical research.

The 2006 Workshop was held at the National Institute of Polar Research (NIPR) on 26 August, 2006. There were 42 participants from 27 institutes, making this meeting the largest in history to date. Participants included medical doctors with Antarctic experience or interested in Antarctica, human biologists and research scientists from other fields, including scientists from the Japan Aerospace Exploration Agency and the Japan Institute of Sports Sciences. As the workshop dealt with practical medical problems, logistic staff members of the expedition were also in attendance.

The resident doctor at Syowa Station joined the discussion through a telecommunication system. JARE has been using the INTELSAT telecommunication system since 2004 to enable real time visual and sound communication for medical consultation between Japan and the Syowa Station.

Eighteen presentations were reported on topics including the International Polar Year (IPY) in medical research, space medicine, telemedicine, an international comparative study of medical operations, psychological surveys, Antarctic high-altitude medicine, Legionella surveillance and nutritional studies. The abstracts follow this text.

Doctors with Antarctic experience from China and Korea also participated in the workshop. They gave presentations on their Antarctic activities, followed by an active discussion session. This was our first occasion to discuss Antarctic medical problems with other Asian participants.

In summary, this workshop grows larger every year and the experience will help to develop long-term cooperation among the Antarctic medical communities in Asia.

2. Outlines of presentations

2.1. International trends in Antarctic medical research—What kinds of issues are dealt with in SCAR and IPY?

G. Ohno (Yoyogi Hospital and JARE-39)

Table 1. Agenda of "Workshop on Antarctic Medical Research and Medicine 2006".

Workshop on Antarctic Medical Research and Medicine 2006
August 26 Saturday, 2006. From 10:00 to 19:00 at NIPR Tokyo

	Opening remarks	M. Fukuchi
Session: Prospective of Antarctic medical research		Chair. I. Obinata
1.	International trends in Antarctic medical research — What kinds of issues are dealt with in SCAR and IPY?	G. Ohno
2.	Space medicine vs. Antarctic medicine — The contact point and future	M. Murai
Session: Medical reports of Asian Antarctic stations		Chair. K. Watanabe
3.	International comparative study of medical services at Antarctic wintering over stations	Y. Hasegawa
4.	Medical care on the Chinese National Antarctic Research Expedition	H. Tong
5.	Medical conditions at King Sejong Station (KOR) and on King George Island	J.W. Hong
Session: Telemedicine		Chair. G. Ohno
6.	Telemedical experiences at Syowa Station	M. Ochi
7.	Possibility of medical health care support to Antarctic Syowa Station through the Kagawa-Medical Internet Exchange System (K-MIX)	K. Hara
Session: Psychological survey in Antarctica		Chair. H. Fujiwara
8.	Survey of the psychological state of the wintering party at Syowa Station	T. Kuwabara
9.	Seasonal changes in subjective sleep evaluation in Antarctica	A. Usui
10.	Why do you get into the lost position? — A scientific analysis of disorientation	T. Aoyama
Session: Other problems		Chair. T. Miyata
11.	Analysis of nutrition during wintering over in Antarctica, and comparison among different countries	M. Nakao
12.	Legionella: Seeking the origin of Antarctic Legionella	N. Shimoeda
13.	Possibility to evaluate health conditions by using plasma amino acids	M. Horiuch
Session: Human responses in Antarctic high altitude		Chair. H. Mikami
14.	A study of cardiovascular function in Antarctic highland	M. Ochi
15.	Human response at Antarctic high altitude — Dome F	K. Obinata
16.	Physiological responses at high altitude in Antarctica using different approaches	S. Otani
17.	Is preliminary training for altitude acclimatization effective? Can mountain sickness be predicted?	T. Maegawa
18.	Introduction of JARE-48 medical team	N. Shiga

Forty-five stations of 19 nations conduct Antarctic wintering over operations. The Expert Group on Human Biology & Medicine (EGHB&M) is the medical division of the Scientific Committee on Antarctic Research (SCAR). Japan has full membership of this group and actively participates. There are four subgroups in EGHB&M: telemedicine, psychology, operational medicine and physiology. The operational medicine group deals with issues such as medical screening, medical facilities, informed medical consent and medical evacuation.

The International Congress on Circumpolar Health (ICCH) is another group conducting polar medical research. It consists of nations mainly operating in the Arctic. The problems discussed in the congress are human responses to the arctic environment and health issues of

Arctic indigenous populations. Japan has reported about its Antarctic activities at the ICCH.

Much international cooperation is progressing for the International Polar Year (IPY) 2007–2008. The EGHB&M is setting about an umbrella project called "Taking the Antarctic and Arctic Polar Pulse (TTAAPP)". The researches within this project are very varied and include Antarctic multinational psychology research project, nutrition and body composition studies, long term medical survey, Concordia Station study, occupational health, the effects on man of geomagnetic variations of space weather, Dome A studies, telemedicine and respiratory system monitoring, seasonal activity variations and microbe monitoring on the Antarctic.

2.2. Space medicine vs. Antarctic medicine—The contact point and future

M. Murai (Japan Aerospace Exploration Agency and JARE-26)

Expanding range and fields of activities have demanded that human beings adapt to many environments, including high mountains, deep seas, Antarctica and space.

Factors affecting space medical problems include low and high gravity, low atmospheric pressure, irradiation, human interaction in isolated small groups and medical operations in space. Adaptation is also a matter of concern in space ship as in Antarctic stations. The progress of environmental control technology and more adaptations for abnormal environments have made it possible for humans to live in such adverse environments. On the other hand, adaptations are not always adequate for humans. Advanced adaptations can make it difficult to return to home society, both physically and mentally.

2.3. International comparative study of medical services at Antarctic wintering over stations

Y. Hasegawa (Kobe Medical Center and JARE-46)

JARE has been conducting winter expeditions to Syowa Station since 1956. Recently, each team has had about 40 participants with two medical doctors. About 1500 personnel have wintered over since 1956. Overall, there have been 5747 medical cases: surgery and orthopedics 46%, internal medicine 23%, dentistry 12%, dermatology 8%, ophthalmology 6%, otolaryngology 3%, and psychiatry 2%.

In 2005, we sent several questions to foreign Antarctic winter-over stations by e-mail and FAX, and conducted an international comparative study of wintering medical services in the Antarctica.

2.4. Medical care on the Chinese National Antarctic Research Expedition

H. Tong (Renmin Hospital of Wuhan University and CHINARE-21)

The wintering over team of CHINARE 21th was based at Zhongshan station. The medical facilities on this base consist of an operating room, a treatment office, a dental chair, a small pharmacy and an X-ray apparatus. Routine physical and mental examinations were performed to monitor the physiological and psychological status of participants and to study the changes in nerve, endocrine and immunological functions. The commonest medical problems through one year were trauma, oral cavity disease, skin disease, digestive system disease and insomnia. Some members also showed emotional instabilities during the winter period.

An expedition was sent to Dome-A (80° 22′ 00″ S, 77° 21′ 11″ E, 4093 m H, −58.4℃,

Ave Tem) for 58 days. The members of this team consisted of 13 males, with an average age of 40. They had been cleared by screening examinations including cardiorespiratory function and had received high altitude land training for 2 weeks. However, with increase of altitude (especially over 3000 m), some members appeared to exhibit a high altitude syndrome. Monitoring of the physiological and mental status of members showed that as time went on some members suffered from anxiety, loneliness and fear. One participant presented with severe mountain sickness at over 4000 m, and was taken away by an international salvage airplane.

2.5. Medical conditions of King Sejong Station (KOR) and King George Island

J.W. Hong (Woori Hospital and KOR 18th wintering over party)

The King Sejong Station of Korea is located on King George Island, in the South Shetland Islands. Nineteen doctors have participated in over-winter research parties from 1988 to 2005. Seven persons have been evacuated from Antarctica in 5 cases. One person died in December 2003 during a boat-wreck rescue of other members. There were 207 medical consultations in the 18th Wintering over team (Dec. 2004–Jan. 2006) and 1 evacuation case was required for a surgical operation.

There are 8 winter-over stations and 1 temporary summer station on King George Island. We investigated the medical facilities at other stations by visiting and compared the differences between the real operation and the Council of Managers of National Antarctic Programs (COMNAP) homepage. Most of the stations, except the Brazilian Ferraz Station, depend on Chile's Frei Station because Frei Station has a medical X-ray system and aircraft.

Two Argentines who fell into a crevasse in September 2005 died of their injuries. The dangerous conditions and the limitations of medical capabilities in Antarctica must have been emphasized by the accidents experienced by the teams from Korea and Argentina recently. This experience will be considered in improving the medical facilities at King Sejong Station and building a new Korean Antarctic station in the near future.

2.6. Telemedical experiences at Syowa Station

M. Ochi (Wassamu Hospital and JARE-46)

Wintering over in Antarctica represents the most remote and inaccessible scenario imaginable for a physician. Telephone and facsimile communications between Antarctica and Japan have been used for years. From February 2004, INTELSAT connections were established at Syowa Station. We started telemedical consultations using a TV conference system *via* INTELSAT connections. These have provided vital links to specialists. E-mail and telephone consultations have also have been used. Telemedicine is a crucial link for specialists from the remote and inaccessible environment of Antarctica.

2.7. Possibility of medical health care support to Antarctic Syowa Station through the Kagawa-Medical Internet Exchange System (K-MIX)

K. Hara (Kagawa University Hospital)

Kagawa Prefecture started the "Kagawa-Medical Internet Exchange System" (K-MIX, http://www.m-ix.jp/), an epoch-making image center project, in June 2003. This project is unique in that the network was developed on the general budget of Kagawa Prefecture, the first project of this kind in Japan led by the prefectural government. Kagawa Prefecture, the

Kagawa Medical Association and Kagawa University Hospital are working together on this project. Local telecommunication carriers (STNet) are in charge of the server management. This system has enabled medical organizations to send medical images easily as long as they are connected to the Internet, even from Antarctic Syowa Station. The number of medical facilities hoping to join this system has gradually increased and 56 facilities participate now. This telemedicine network will be very useful for the health care of personnel at Syowa Station in the future.

2.8. Survey of the psychological state of the wintering party at Syowa Station

T. Kuwabara (Kyoto University)

The purpose of this survey was to investigate the psychological characteristics of the wintering party at Syowa Station, who must live in a closed world for long periods. We compared our results with those of two other countries.

Participants were all members of the wintering party during the 45th and 46th Japanese Antarctic Research Expedition, 2004–2006. The survey was conducted using the Baum test and four questionnaires: PANAS, COPE, SHC, and TSPS. This set of psychological tests was performed six or seven times throughout the wintering period.

(1) International Comparisons: The Japanese party scored lower on the positive affect scale than the Italian and Uruguayan parties and higher on the negative affect scale (PANAS). This implies that the Japanese culture, which has a life-style including many feelings of negativity, is the cause behind this sort of attitude. *(2) Annual Comparisons*: Half of the subjects suffered from sleep problems in the polar night. In the Baum test, the number of types of trees was increased at polar daybreak.

External factors, individual traits, and interpersonal relationships all have a strong influence on the psychological conditions of members of an Antarctic wintering party. Moreover, we found that the feelings and ways of coping with stress varied depending on personality type. Understanding the members' psychological conditions is important for supporting their mental health.

2.9. Seasonal changes in subjective sleep evaluation in Antarctica

A. Usui (University of Yamanashi)

Last year, we reported seasonal changes in the sleep phase, the phase of serum melatonin, and mood in Antarctica and Japan. In this study, seasonal changes in subjective sleep evaluation were investigated.

Subjects were eight males (35.8 y/o) of JARE, and six females and four males (28.9 y/o) in Japan. The subjects filled out the OSA (Oguri, Shirakawa, and Azumi's) Sleep Inventory for more than one year. From this inventory, five sleep factors can be defined. These factors are as follows: Factor 1, sleepiness; Factor 2, sleep maintenance; Factor 3, anxiety; Factor 4, integrated sleep; Factor 5, sleep initiation. For each score, daily differences from individual annual averages were computed. Then, individual monthly averages were calculated. A one-year cosine curve for each group was obtained by multiple regression. For the calculations, the months were converted to degrees. Each amplitude of the curve was statistically analyzed by ANOVA.

In Antarctica, the Factor 2, Factor 3, and Factor 5 scores were lowest in midwinter. In Japan, Factor 5 score was lowest in summer.

2.10. Why do you get into the lost position?—A scientific analysis of disorientation

T. Aoyama (Kansei University)

The lost position (LP) is the first or second most important reason for mountain accidents, and its incidence is increasing every year. LP is usually accompanied with wondering, illusion, hunger, and fear of death, which tend to cause other accidents. The background of LP is very difficult, in that many survivors say they never know why they fell into LP. Human errors are related to the ability for orientation, map reading, physical capacity, character and experience. Also, geographical features, weather, season and time influence LP. Experimental orienteerings were conducted in a poor visibility field with a map, but no compass. Under such situations with little information, participants tended to consider the trail as the most reliable basis and keep their direction by the relative position of destination to the path at the starting point, even though the path takes innumerable curves. And once LP happens, it is hard to recover and to obtain a correct orientation.

2.11. Analysis of nutrition during wintering over in Antarctica and comparison among different countries

M. Nakao (Kobe Women's Junior College)

The nutrition of wintering personnel at Syowa Station was analyzed. The analysis was performed employing digital images of all food consumed. Food consumption was estimated from the image. Energy and nutrient consumption were determined using food content software.

The energy consumption throughout one year in 1998 was sufficient, compared with the nutritional standard for normal Japanese citizens. The proportion of protein and fat intake were higher and carbohydrate was lower than the nutritional standard. The consumption of Vitamin C, fiber and calcium showed insufficiency.

Nutritional comparison was performed between the Korean and the Japanese teams during the first week in August of 2005 using the same method. We failed to analyze Korean food correctly, due to poor understanding of Korean recipes and ingredients.

The digital image analysis of food was revealed to be a very useful method. However, to compare between nations it is necessary to understand the food culture of the foreign countries involved and to enhance cooperation among nations.

2.12. Legionella: Seeking the origin of Antarctic Legionella

N. Shimoeda (Simotsuga General Hospital and JARE-43)

A microbiological study of the 24-hour circulating bath system at the Antarctic bases showed Legionella and other microorganisms. The circulating bath is known to have the potential to allow the growth of many microorganisms, including pathogenic bacteria such as Legionella. Legionellosis, which develops into severe pneumonia, may be difficult to manage in the Antarctic winter.

We have conducted a microbiological study of the circulating bath system, from 1998 to 2004, at two Japanese Antarctic stations, Syowa Station and Dome Fuji base. The water at both stations is prepared by melting snow. Water samples, including the bath sink and the filter of the bath circulation system were collected and stored frozen or in cold storage. After bringing the samples back to Japan, examination revealed that specimens from both stations from the bath water and the filter of the water-supply system, showed positive results for

Legionella-specific DNA by the PCR method. These samples, however, were all negative when the culture method was employed to test for Legionellae. The results mean that contamination with the microbe has taken place, though the risk of legionella infections is still low. It is important to ensure the culture of Legionella in order identify the origin and transmission of the organism.

2.13. Possibility to evaluate health conditions by using plasma amino acids

M. Horiuchi (Kagoshima University)

Amino acids (AAs) in plasma have been used for evaluating health conditions, such as liver dysfunction and malnutrition. During Antarctic wintering over, many studies regarding biochemical changes in plasma have been done, especially on thyroid hormones. However, AAs in plasma have not been analyzed. This report reveals an alteration of AAs in plasma during one-year residency in Antarctica, and the factors influencing the AAs are discussed.

Most AAs showed no significant changes during the term. Eight AAs including arginine, ornithine, alanine, cystine, threonine, isoleucine, tyrosine and lysine were altered. To understand the cause of the alteration, we performed an animal experiment: AAs in plasma of mice exposed to ultraviolet irradiation were examined. Ultraviolet irradiation is an important environmental factor in Antarctica. We discuss the cause of the alteration of AAs found in one year residents in Antarctica, on the basis of the animal experiment.

2.14. A study of cardiovascular function in the Antarctic highland

M. Ochi (Wassamu Hospital and JARE-46)

I have conducted three medical research studies during the winter-over period at Syowa Station and during an Antarctic highlands journey to Dome Fuji base: 1) Vital sign changes in the Antarctic highlands. 2) Atrial natriuretic polypeptide (ANP) and brain natriuretic peptide (BNP) change in the Antarctic highlands. 3) Holter ECG recording and analysis in the Antarctic. Many participants who have not been specially trained for activities at high altitude are at risk of physical problems, including cardiovascular disorders, when exposed to a high-altitude environment. The aim of my research is to study how to prevent and detect acute mountain sickness. Initial results show individual differences, but I conclude that the journey from Syowa Station to Dome Fuji base is safe. Complete analyses are now in progress.

2.15. Human response at Antarctic high altitude—Dome Fuji Station (Dome F)

I. Obinata (Nanbugo General Hospital and JARE-44)

JARE manages Dome F base at S77, E39, and 3810 m a.s.l. with an average atmospheric pressure of around 600 hPa. Wintering over expeditions have been held there 4 times. The Dome F wintering team used a snow tractor approach from Syowa Station (S69, E39, 29 m a.s.l.) which took 3 weeks. The team had no symptoms of acute mountain sickness. It is concluded that a gradual approach allows adaptation to high altitude.

A decrease of arterial O_2 saturation and increase in average blood pressure were shown with altitude and these levels at arrival persisted for one wintering year without recovery to previous levels. The average pulse which increased about 20% compared with near sea level at arrival tended to calm down at the end of wintering. Periodic breathing (Cheyne-Stokes breathing) appeared frequently, about 10 to 80% a night. Body weight decreased until

September. The body weights of obese members decreased more significantly compared with muscular members. Uric acid, lactic acid and hematocrit showed increases. It is thought that hematocrit was increased for polycythaemia and purine metabolism (degradation) is activated at high altitude to make ATP, and then, the final product UA is increased.

2.16. Physiological responses at high altitude in Antarctica using different approaches

S. Otani (Hino Hospital and JARE-40)

Dome Fuji Station (Dome F) is located 3810 m above sea level (77º 19′ S, 39º 42′ E). Inland parties to Dome F originally drive snow vehicles. Recently, approaches by airplane have been employed. We have to evaluate the risk of altitude sickness with airplane transport and compare the differences between the air and land routes in terms of physiological responses. There was no severe mountain sickness in any party, and it was expected that it would not be difficult to adapt to high altitude when traveling by air. However, the body temperature and pulse rate increased when the air party reached 3000 m above sea level and showed a tendency to return to normal levels within a few days. The levels of Arterial oxyhemoglobin saturation during the Dome F stay were higher in the land route party than the air party.

2.17. Is preliminary training for altitude acclimatization effective? Can mountain sickness be predicted?

T. Maegawa (Japan Institute of Sports Sciences)

It is well known that traveling in the highland can induce acute mountain sickness. Repeated exposure to hypoxic training, for example exercise or sleeping in a normobaric hypoxic room or a hypobaric chamber, is effective in accelerating preliminary acclimatization for a hypoxic environment and reduces the risk of high altitude disease. Such training just before departure could help in achieving acute acclimatization for the highland.

It would be useful to estimate adaptability to the highland in advance to analyze the heart rate and arterial O_2 saturation changes with incremental exercise under hypoxic conditions, making it possible to estimate the physical and mental response to exposure to high altitude. However, it remains difficult to predict mountain sickness or disorders.

2.18. Introduction of JARE 48th medical team

N. Shiga (JARE-48)

The specialties of the two JARE-48 doctors are emergency medicine and surgery. The medical research program that has been discussed includes cardiovascular monitoring and a psychological survey. Proposals are welcomed.