Variation in the Susceptibility to Cold Injury in Indians

by
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ABSTRACT — The peripheral vascular responses during local cold stress, (heat output from the hands and cold induced vasodilatation - CIVD response) were studied on 4 groups (10 each) of Indian population, viz., South-Indians, North-Indians, Gurkhas and High Altitude Natives (HAN) of 3,500 m. The parameters were recorded at Delhi, and at 3,500 m in thermoneutral laboratory (25-28°C). The sea level readings of HAN were taken after 3 weeks of their stay at Delhi; and that of lowlanders at 3,500 m were taken after 3 weeks of their sojourn. The results show that the heat output and CIVD were highest in HAN, and lowest in the South-Indians. The responses of the other two groups were similar in nature and were better than that of South-Indians. Based on an earlier study which has shown that individuals with higher heat output and CIVD are better protected against the occurrence of cold injuries, it can be suggested that HAN are most resistant and the South-Indians are highly susceptible to the occurrence of cold injuries.

INTRODUCTION

Considerable differences are seen among individuals in their susceptibility to cold injury. When a body of troops are exposed to identical cold conditions during military operations, only a few of them suffer from cold injuries. This may be due to the differences in their cold tolerance and the state of peripheral blood flow under cold stress, and an ethnic or racial factor may be involved in it. This racial factor was noticed in the Korean War, where the incidence of cold injury was higher in Negroes than in Whites (Orr and Fainer, 1952). Among Indian population, it is possible that people of certain regions are more susceptible to the occurrence of cold injuries as compared to others, owing to regional, climatic and cultural differences.

It has been suggested that men with higher cold induced vasodilatation (CIVD) response are less prone to the occurrence of cold injuries (Teichner, 1963). It was shown that natives of cold regions and cold acclimatised men, who showed higher peripheral blood flow under cold exposure were less liable to cold injuries (Kroget al., 1960, Leblanc, Hildes and Héroux, 1960). This might be due to the higher blood supply to the extremities under cold exposure, which can be estimated by CIVD response or heat output under the same conditions (Rai and Purkayastha, 1972). It was found that these parameters were well correlated to the degree of cold injury in monkeys and that animals with higher heat output and CIVD response were comparatively better protected against frostbite (Mathew et al., 1975). It is also shown that drugs that elevate these responses decrease the

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chances of the occurrence of cold injuries (Malhotra et al., 1977). This means that individuals who show poor response of CIVD and heat output under local cold exposure are more prone to cold injuries, and hence these parameters are used in this study to see the regional variation, if any, in the susceptibility to cold injury of Indian Subjects.

MATERIALS AND METHODS

Four groups (10 each) of volunteers, viz South-Indians, North-Indians, Gurkhas and Ladakhis (high altitude natives of 3,500 m) have participated in this study. They were 20-30 years of age. Prior to the experiment they were made to rest in a temperature controlled room (25-28°C) for a period of one hour without smoking. The subject sat on a chair comfortably and their CIVD response was elicited by immersing the right hand up to the level of styloid process, in a constantly stirred water-bath (25 lits) maintained at 4°C ± 0.2°C by addition of ice water. The temperature of the water bath as well as the changes in the skin temperature of the tip of index finger (ventral side) of the immersed hand was measured at the beginning and thereafter every minute for a period of 30 min. All the temperature measurements were made with YSI telethermometer. The probe was attached to the skin surface with double layers of adhesive plaster. A thin layer of grease was also applied above the adhesive tape to confirm that no water droplet entered through the tape.

After a period of one week the heat output of these subjects were estimated in the same room using calorimetric technique (Hellstorm and Andersen, 1960), by immersing the right hand in water at 4°C up to a previously marked level on the wrist for a period of 30 min. The subjects sitting comfortably on chair were instructed to keep the fingers and hands relaxed. A wide mouth thermosflask of 3 liters capacity with 1,500 ml of water at 4°C was used. Throughout the experiment, the water inside the flask was stirred by a motor driven stirrer at 100 rpm. The temperature of the water inside the thermosflask was measured at the beginning and thereafter at 5-min interval. The heat output was calculated according to the relation.

\[ H = (M + W) \Delta T \]

where H is the heat output from the hand; M is the mass of water in the calorimeter; W is the water equivalent of the calorimeter and \( \Delta T \) is the rise in temperature of water. The water equivalent of calorimeter was determined by adding 500 ml of water at 50°C to 1000 ml water at 4°C inside the flask and measuring the rise of temperature. The rise of water temperature during the last 25 min of the immersion period was used to calculate the heat output after applying a half-time correction of the rise in water temperature due to radiation. Hand volumes were determined by simple displacement method (Elsner, Nelms and Irving 1960).

The responses of altitude natives were taken after 3-4 weeks of their stay at Delhi. Further, the measurements were repeated in a similar manner in all the subjects except the Gurkhas at an altitude of 3,500 m. The readings were taken after 3 weeks of their stay at high altitude.

RESULTS

The mean heat output value of High Altitude natives (HAN) when tested at Delhi was 629.1 ± 37.8 J/(100 ml. min) whereas their value at altitude was only 539.8 ± 31.2 J/(100 ml. min); the difference being statistically significant (P < 0.001). The North Indians had a mean heat output of 530.5 ± 44.8 J/(100 ml. min) as against 397.4 ± 25.3 J/(100 ml. min) of South Indians and 539.1 ± 38.6 J/(100 ml. min) of Gurkhas, at Delhi. These were significantly (P<0.001) less at altitude for North and South Indians, the values being 376.7 ± 32.5 and 278.0 ± 17.9 J/(100 ml. min) respectively. It is seen that natives had significantly