Trop. Med., 30 (1), 45−48, March, 1988

Poor Heat Loss Ability of Pika (Whistle Rabbit)*

Guo-Jie YANG, Takaaki MATSUMOTO, Mitsuo KOSAKA,
Masaki YAMAUCHI and Nobu OHWATARI

Department of Environmental Physiology, Institute of Tropical Medicine, Nagasaki University, 12−4 Sakamoto-machi, Nagasaki 852, Japan

Abstract: Pikas (Whistle rabbit) are old-fashioned rabbits which had survived the Age of Ice, and have characteristic short rounded ears. We have reared pikas since 1985 and reported their higher metabolic rate, higher body temperature and pyrogenic response (intravenous lipopolysaccharide pyrogen) previously. In the present experiment pika's heat loss ability was examined and discussed from the view point of thermoregulation. During heat exposure (30℃, 33℃, and 40℃, 60%rh), thermal panting was observed in rabbits, however, no increase in respiratory rate was observed in pikas. Noteworthily two pikas rapidly increased the rectal temperature at heat exposure (40℃, 60%rh) and then finally died after 90min, of which rectal temperature was 44.0℃ and 43.1℃, respectively. Laboratory albino rabbits survived this experiment. Though the radiation from ear surface is the main heat loss mechanism for rabbits, the ear surface area ratio to body surface area in pikas was small compared to rabbits. It was 7% in pikas and 17% in rabbits. These results revealed the poor heat loss ability in pikas constituted by smallness of ear surface area and lack of thermal panting.

Key words: Pika, Heat loss ability, Thermal panting, Ear surface area, General heating

Pikas (*Ochotona rufescens rufescens*) are old-fashioned rabbits, which had survived the Age of Ice. They have short rounded ears and weigh less than 300g. Members in the genus *Ochotona* inhabit above timber line or in cold zone and in high mountain ridges such as Himalaya, Alaska, Manchuria, Rocky Mountains and Ural Mountains (Goodwin, 1968).

At the standpoint of temperature regulation, the oxygen consumption of pika is greater than that of cold-acclimated rat. Rectal temperature of pika is higher than that of such small animal of equal body weight and that of laboratory rabbit (Kosaka *et al.*, 1985). The lipopolysaccharide (LPS) pyrogen intravenously administrated in pika evoked a

Received for Publication, February 18, 1988.
Contribution No. 2130 from the Institute of Tropical Medicine, Nagasaki University.
*All Pikas were reared at the Animal Research Center for Infectious Tropical Diseases, The Institute of Tropical Medicine, Nagasaki University.

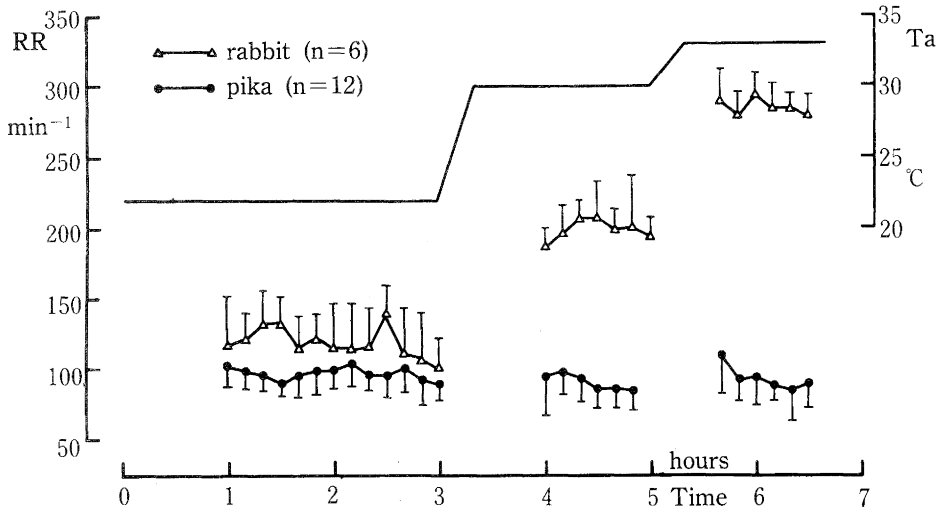

Fig. 1. Comparison of the changes in respiratory rate (mean±SD) due to general heating between rabbits and pikas. Relative humidity: constant at 60%.
RR: Respiratory rate, Ta: Ambient temperature

monophasic fever which was accompanied by piloerection and shivering during the rising phase of fever curve (Kosaka *et al.*, 1987). In addition, pika had the pyrogenic response to intravenous recombinant human interleukin-1α (rhIL-1α) (unpublished data).

Although the heat radiation from ear skin surface is one of the major heat loss mechanism for rabbits, the ratio of ear surface area to body surface area in pikas is markedly small compared to laboratory rabbits. It was 7% in pikas and 17% in rabbits (unpublished data). Another major heat loss mechanism is panting phenomenon in rabbits. In this investigation respiratory heat loss ability of pikas was examined.

The pikas which have been reared at the Animal Research Center for Infectious Tropical Diseases, The Institute of Tropical Medicine, Nagasaki University since 1985 were obtained from Central Institute for Experimental Animals (Matsuzaki *et al.*, 1979). Originally they were collected from Afganistan by Puget in 1969 (Puget, 1973 a, b), and have been reared individually at 22℃ in accordance with Puget's method.

Significant increase in respiratory rate due to the elevated ambient temperature (30℃, 33℃) at a constant relative humidity of 60% was observed in the laboratory rabbits ($p<0.001$), while there was hardly any increase in the pikas even at 33℃ (Fig. 1). On the contrary there was a slight decrease in respiratary rate ($p<0.01$). In addition, the pikas seemed to be exhausted in high ambient temperature. It is believed that the pikas are exposed to larger amount of heat than the rabbits because the body surface area ratio to body weight in pikas is large compared to that in rabbits, however, thermal panting was not observed in the pikas during general heating.

Furthermore, at 35℃ ambient temperature, similar results in respiratory rates were

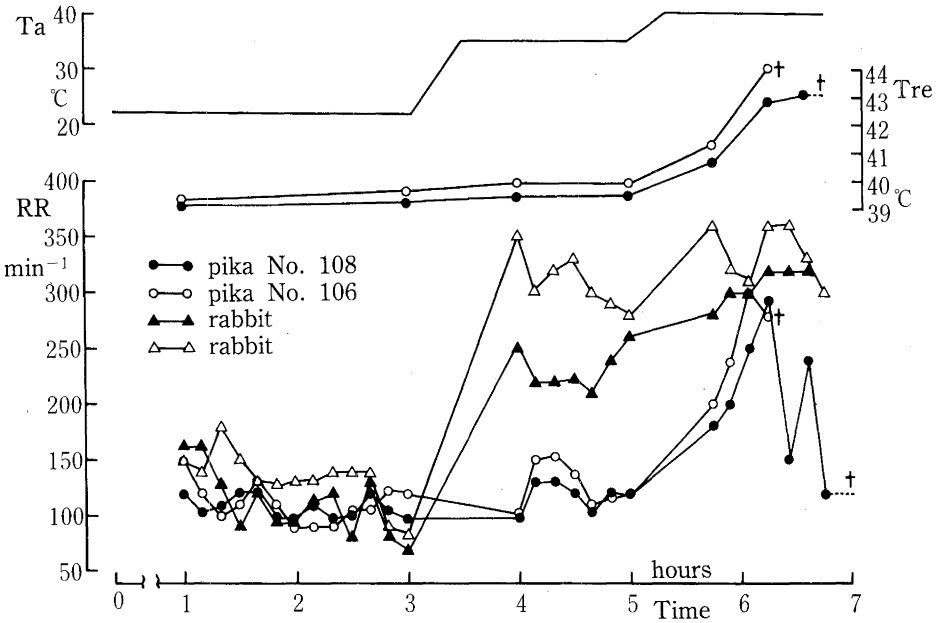

Fig. 2 The changes in rectal temperature and respiratory rate of two pikas and two rabbits due to intense general heating. Relative humidity: constant at 60%. † represents death. RR: Respiratory rate, Tre: Rectal temperature, Ta: Ambient temperature

obtained to those observed at 30℃ and 33℃ with a little increase in rectal temperature in the pikas (Fig. 2). When they were exposed to 40℃ ambient temperature, the rabbits did not seem to be exhausted with the increase of respiratory rate. In contrast the pikas lay down on the mesh wire cage floor with their limbs stretched and sometimes they jumped to the cage wall as if they were confused in a rage. Noteworthily, during heat exposure at 40℃ and 60%rh, the rapid increase in rectal temperature of the pikas was observed, then finally one pika died after 60min with its rectal temperature at 44.0℃ and the other died after 15℃−60min following to 40℃−90min with its rectal temperature at 43.1℃. The rabbits survived this experiment. It is undetermined whether the heat loss mechanism in pikas is the same as in laboratory rabbits or not, however, pikas belong to the same order *Lagomorpha* as laboratory rabbits. Grooming behavior was also observed in the pikas in this experiment.

From these results poor effective heat loss ability in pikas is most probable due to smallness of the ears as the heat radiator and lack of thermal panting. Looking from another angle, the excellent heat conservation ability that pikas possessed is considered to be favorable for survival in the cold environment such as the glacial epoch.

Pikas are attractive laboratory animals for the research not only of temperature regulation but also of thermal adaptation. In addition, we have an impression that pikas have fairly high sensitivity to drugs especially anesthetics. As the data in the physiological

studies on pikas are still sparse further studies are expected to clarify the peculiar thermophysiological characteristics of pikas.

ACKNOWLEDGEMENTS

The authors greatly acknowledge Dr. Sachiko Matsuo and Mr. Toshiyuki Moriuchi (Animal Research Center for Infectious Tropical Diseases, The Institute of Tropical Medicine, Nagasaki University) for the cooperation to breed pikas. The authors also wish to thank Miss Junko Kawashima and Miss Junko Hayashima for their typing and drawing.

REFERENCES

1) Goodwin, G. G. (1968): Pika in Collier's Encyclopedia. pp 46. *In* Crowell-Collier Educational Corporation, USA, vol. 19.
2) Kosaka, M., Ohwatari, N., Iwamoto, J., Tsuchiya, K., Fujiwara, M., Fan, Yu-Jen, Matsuo, S., Moriuchi, T. & Matsuzaki, T. (1985): Studies of temperature regulation on Pika (*Ochotona rufescens rufescens*); An old fashioned rabbit. Trop. Med., 27 (4), 289−294.
3) Kosaka, M., Yang, Guo-Jie, Riwa, P. G., Matsumoto, T., Ohwatari, N. & Fan, Yu-Jen. (1987): Pyrogenic response in pika (whistle rabbit). Trop. Med., 29 (3), 175−179.
4) Matsuzaki, T., Saito, M., Yamanaka, M., Esaki, K. & Nomura, T. (1980): Breeding and rearing of Pika (*Ochotona rufescens rufescens*) as a new labolatory animal species. Exp. Anim., 29, 165−170.
5) Puget, A. (1973a): *Ochotona rufescens rufescens* in captivity: reproduction and behaviour. J. Inst. Anim. Tech. 24 (1), 17−24.
6) Puget, A. (1973b): The Afgan pika (*Ochotona rufescens rufescens*): A new labolatory animal. Lab. Anim. Sci., 23(2), 248−251.

ナキウサギ（Pika, Whistle rabbit）の弱熱放散能

楊　果杰，松本孝朗，小坂光男，山内正毅，大渡　伸（長崎大学熱帯医学研究所環境生理）

ナキウサギ（Pika, Whistle rabbit）は，氷河時代を生き抜いた古いウサギであり特徴的な短く丸い耳を持っている．我々はこのナキウサギを飼育し，その代謝や体温が高く，また外因性発熱物質である LPS-pyrogen により発熱性を有することを報告してきた．今回，ナキウサギの熱放散能について検討した．30℃および33℃，相対湿度60％の環境条件にて，家兎ではパンティング（浅速呼吸）が出現したのに対し，ナキウサギではその呼吸数は全く増加しなかった．さらに注目すべきことに，40℃，相対湿度60％では，ナキウサギの直腸温は，急速に上昇し，遂には一羽では44.0℃，もう一羽では実験中止一時間後43.1℃となり死亡した．他方，この実験により死亡する家兎はいなかった．また，家兎の主たる熱放散機構は，パンティング及びその長い耳からの放熱であるが，ナキウサギの耳は小さく，因にその体表面積あたりの比率は，家兎17％に対し７％にすぎない．このように，ナキウサギの熱放散能は乏しく，それは熱放散器官である耳の面積が小さいこととパンティングの欠如によると考えられる．

熱帯医学　第30巻　第１号，45−48頁，1988年３月