From Bio-velocity to biological clock

M. Yamamura
Dept. of biochemistry, Tokai University, School of Medicine
Isehara, Japan

Introduction

Thermodynamic was applied in the field of biology. A part of heat produced because of work done by our body remained in our body as body temperature. The excess heat released out from body as the free heat. Body temperature kept at constant level means that heat is continuously supplied as the result of work. As work done is expressed as the equation of motion, a positive velocity must exist as long as we were alive. Velocity varies according to the state of our body, such as exercising, sleeping, growing-up and aging.
In this small article, velocity of mouse, which is called as bio-velocity, was calculated from the measurement of free heat. In human, bio-velocity was calculated from basic metabolic rate.

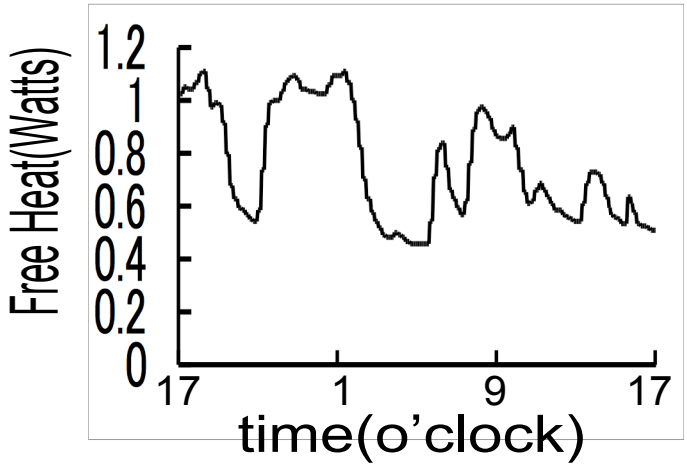
Methods and materials

Mice measured were ICR, C3H, CDF-1, BALB/c, CBA, db/-, aged from 4weeks old till their natural death. A total of 3766 measurements were performed.
Free heat was measured in watts by a whole body calorimeter. Food and water was provided within the calorimeter. Before mouse was placed, temperature equilibrium has been established for at least 14 hours. A mouse was placed in a calorimeter at 9:00 till the following day at 17: 00 hour. Data were digitalized and lead to computer using software called Labview by national instruments. Data analysis was made using the data from 17:00 to the following 17:00.
Velocity was calculated from 24-hour integrated free heat. 1% of the integrated heat was to be work done. Using the equation of motion, velocity was calculated at every 10 weeks of age.
In human, velocity was calculated from basic metabolic rate, which was calculated from average height/body weight of various age 1 to 70 years which was presented from the ministry of health and labour welfare

Results

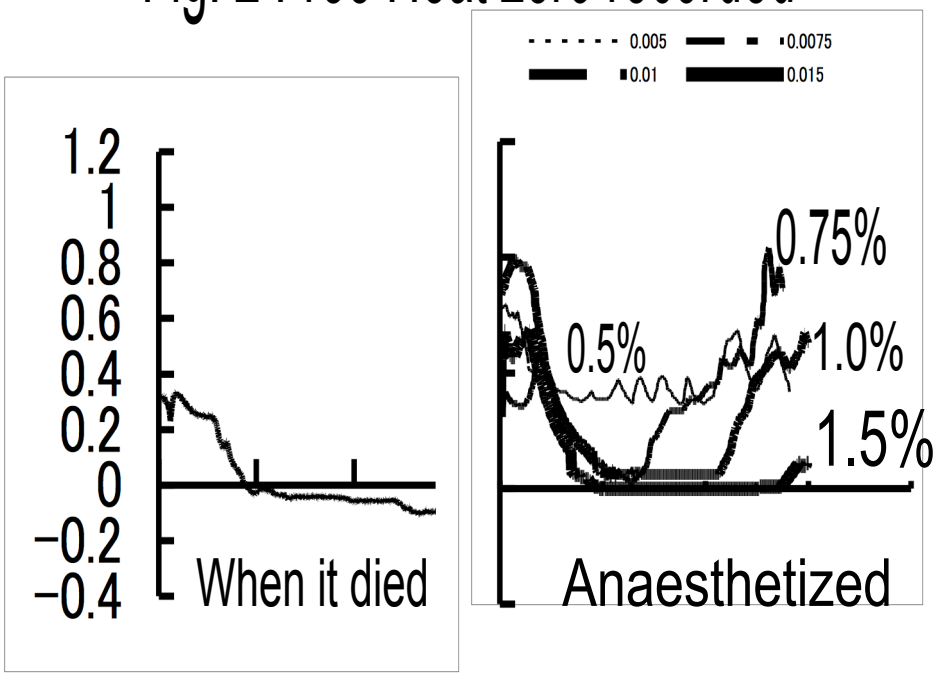
The pattern of free heat 24-hour change was clearly a representation of a circadian rhythm of a mouse. See figure 1.

Fig. 1 Circadian rhythm of a mouse

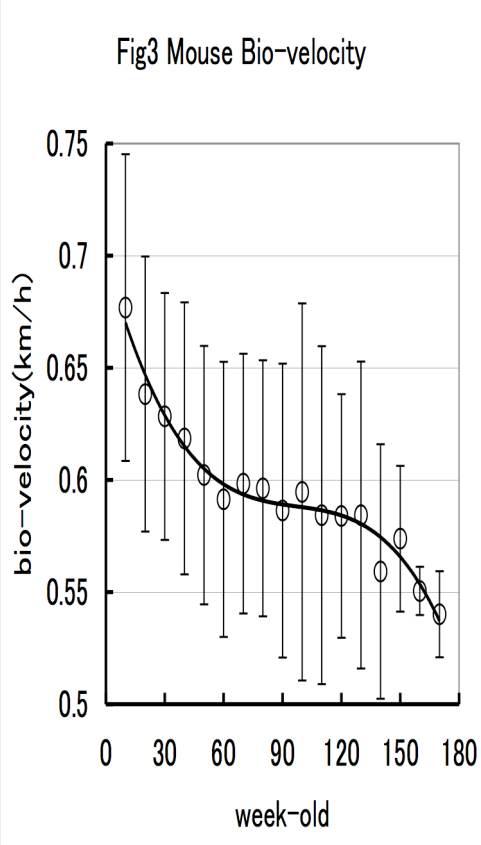


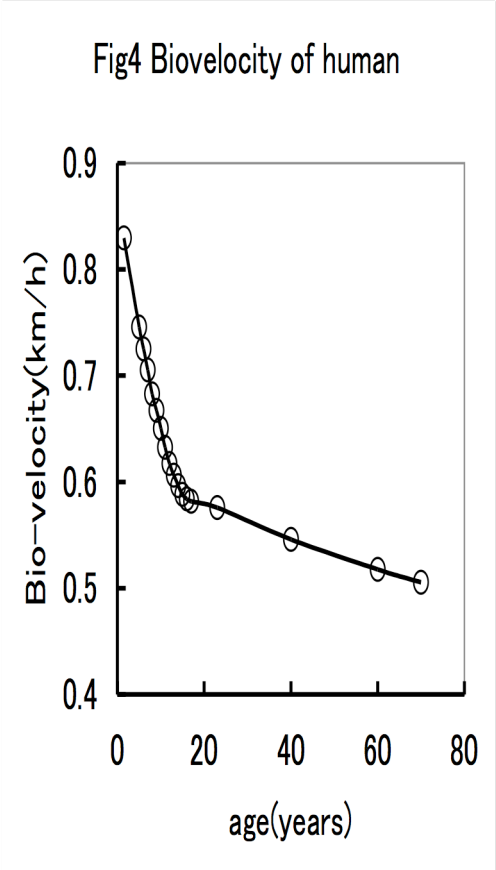
Free heat always gave positive values with only two occasions, one was that a mouse died and the other was anaesthetized. See figure 2.

Fig. 2 Free Heat zero recorded



The speedy reduction in bio-velocity was noted for the first 60 weeks and the moderate reduction occurred following 60 weeks. A few weeks before the final day, it seemed speedy reduction of bio-velocity again noted. see fig. 3
In human, the reduction of velocity was also seen as in mouse. Not only the pattern of reduction but also the value of velocities were similar.





Discussion
It is clearly demonstrated in mouse as well as in human that the velocity is similar and the older it become, the slower the bio-velocity become. This is the first time that the state of a body like ageing is expressed as bio-velocity.
Velocity is displacement per unit of time, therefore as time passes, a distance appears. If the distance is articulated as a coil orbit, a biological one-day can be defined as the completion of one cycle on the coil orbit. This biological one-day, which shall be called a biological clock, is entirely independent from one-day set by earth time. Unlike earth time, the biological clock is not uniform but is fluctuate due to bio-velocity. That is to say that the faster bio-velocity as in young age

is, the shorter biological–one day becomes. Inversely the slower bio–velocity as in older age is, the longer biological one–day becomes. At an older age, to complete one cycle on the orbit, it should take much longer. In other word, although earth time says one day has ended, biological clock says not yet. This difference is the cause for the feeling “the older one gets, the faster earth time passes”