misalignment associated with space flight, shiftwork, and circadian rhythm sleep disorders.(1) Wright Jr. KP et al. PNAS 98:14027-32, 2001. (2) Gronfier C et al. Am J Physiol (E), in press.Support: NASA Cooperative Agreement NCC 9-58 with the National Space Biomedical Research Institute (NSBRI), NASA Grant NAG 5-3952, NIH MO1-RR02635 – GCRC

009

Input Pathway of the Circadian Period in Cyanobacterium Synechococcus Elongatus PCC 7942

Naoki Takai, Shingo Ikeuchi, Katsushi Manabe, and Shinsuke Kutsuna* • Yokohama City University

Environmental light condition modulates the phase and period of the circadian clock. Although several photoreceptor proteins that receive light for the clock regulation were identified, little is known about the input-pathways, which transmitted environmental cues, such as light-signal from the receptor to the clock to reset circadian phase and/or period. Previously, in the model organism cyanobacterium Synechococcus elongatus PCC 7942 a period-extender gene (pex) has been identified as a period lengthening factor about 1-hour in the oscillator. Here we show its role in the input-pathway. pex mRNA and its protein expressed at low level in light, and increased in dark. This derepression repeated under dairy dark period. Even thought, pex-disrupted strain (pex-d) exhibits the short period phenotype, continuous light grown pex-d could coordinate the peak timing of expression of kaiBC operon (kaiBC-timing; used as temporal marker of the clock-movement) at the same time to the one in wild-type (wt) after a 12-hours-dark entrainment, appeared to retain normal function of typical light-entrainment in pex-d. But the pex-d having experience of three diurnal light/dark cycles for 3-days exhibits advanced kaiBC-timing by 3-hours than the one in wt. Consistently, ectopic induction of pex-trans-gene (pex-i) caused the delay in the bioluminescence rhythm. To determin the genetic structure of the input pathway, we examined the expression level of clock genes in the pex-d strain. And we found significant increase of accumulation level of the positive factor KaiA in the mutant. On the other hand, pex-i strain exhibited low level in KaiA level.

010

Initial Steps Towards a Circadian Compromise for Night Shift Workers

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This is the first installment of a multi-part study to determine if circadian adaptation (re-alignment of the temperature minimum (Tmin) to within daytime sleep) can be achieved and maintained while alternating between working night shifts and having days off. Subjects were required to sleep from 23:00 to 07:00 (and up to 1 h later on weekends) for 3 weeks. Following this baseline period, they worked 2 consecutive simulated night shifts (23:00Ð07:00). Experimental subjects (n=11) received five 15-minute intermittent bright light pulses (~3500 lux; ~2200 microW/cm2) during the night shift, wore sunglasses (~12% transmission) while traveling home, and slept in the dark (08:30Ð15:30) after each night shift. Control subjects (n=8) received ordinary room light (~20 lux) throughout the night shift, wore sunglasses (~37% transmission), and slept whenever they wanted after the night shifts. The Tmin (dim light melatonin onset + 7 h) was determined before and after the night shifts. Tmins (mean ± SD in h) for the experimental subjects were 04:24 ± 0.8 and 7:36 ± 1.4, respectively; for control subjects, they were 04:00 ± 1.2 and 4:36 ±

1.4. Thus far, the experimental treatment phase delayed the Tmin by 1.6 h/day. After one more night shift, we expect the Tmin to delay to within daytime sleep. Given a fairly late sleep schedule on days off, this phase position would be an ideal compromise between working nights and having days off. Support: R01 OH003954.

011

Daily Activity Patterns of a Nocturnal and a Diurnal Rodent in a Semi-natural Environment

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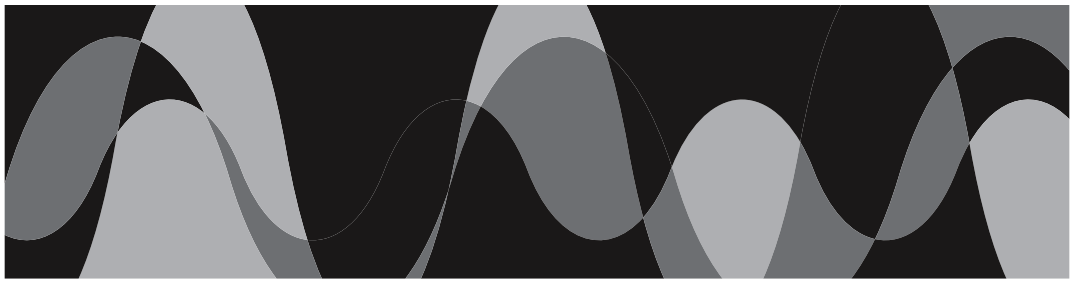
The entrainment of circadian rhythms by light-dark cycles has been extensively investigated in laboratory studies. In almost all of these studies, organisms have not been allowed to modulate their exposure to the light-dark cycle. In the present study, the rhythm of running-wheel activity was investigated in nocturnal (domestic mice) and diurnal (Nile grass rats) rodents provided with light-tight nest boxes and maintained under long and short photoperiods. Photoperiod length had a significant effect on the duration of the daily active phase (alpha), on the phase angle of entrainment (psi), and on diurnality or nocturnality in both species. The availability of a nest box had a modest effect only on the variability of activity onsets. Although the animals spent most of the inactive phase (rho) inside the nest box, they entered and exited the box many times during both the active and inactive phases. Neither in the nocturnal nor in the diurnal species was there any evidence of entrainment by frequency demultiplication or of entrainment without photic stimulation at either dawn or dusk. These results indicate that, at least in the species studied, the ability of rodents to modulate their exposure to the light-dark cycle does not have a major effect on photic entrainment. Therefore, there is no reason to question the validity of the multitude of previous laboratory studies that utilized inescapable light-dark cycles.

012

A Place for ZTL in Circadian Phototransduction a Place for ZTL in Circadian Phototransduction

Woe-Yeon Kim and David E. Somers* • Ohio State University

The entrainment of the circadian clock in plants is mediated through the red light-sensing phytochrome and blue light-sensing cryptochrome photoreceptors. Fluence rate response curves of mutants in a third class of molecule, ZEITLUPE (ZTL), show enhanced effects on free-running period at low fluence rates in both blue and red light, indicating that this protein also mediates light signaling to the central pacemaker. ZTL is an F-box protein that appears to target a key component of the circadian pacemaker, TOC1, for proteasome-dependent degradation. A novel element of ZTL is an N-terminal flavin-binding motif (LOV domain), which is consistent with the fluence-dependent effect of ztl mutations in blue light, but does not explain the equally strong effect of the mutations in red light. We have created double mutant combinations between ztl-1 and select phytochrome and cryptochrome mutants to determine the nature of the contribution of ZTL to circadian phototransduction, in the context of the known phytochrome and cryptochrome signaling pathways. Preliminary data suggest that ZTL and phytochromeB share parallel or overlapping pathways, as ztl-1 phyB double mutants are more severe than either alone. Results



Ninth Meeting

Society for Research on Biological Rhythms

Program and Abstracts

SRS/SRBR

June 23, 2004

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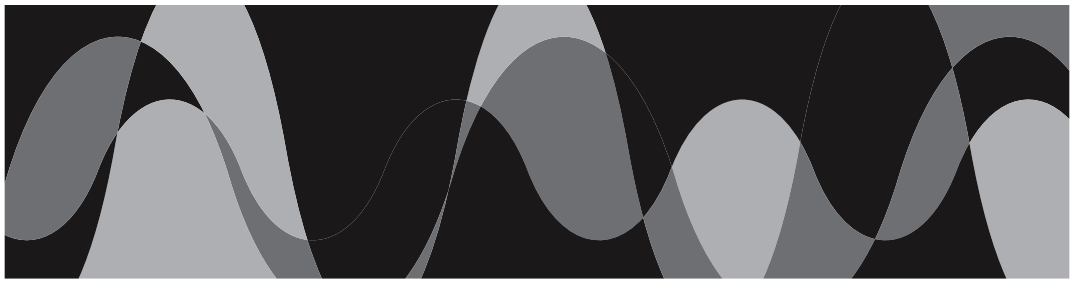

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The SRBR wishes to thank the following for their contributions:

ALA Scientific Instruments
American Laboratory Products
Mini-Mitter Company
National Aeronautics and Space Administration
National Institutes of Mental Health
National Science Foundation
Sage Publications