BINGE DRINKING HISTORY ALTERS SLEEP HOMEOSTASIS IN FEMALE MICE

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Introduction

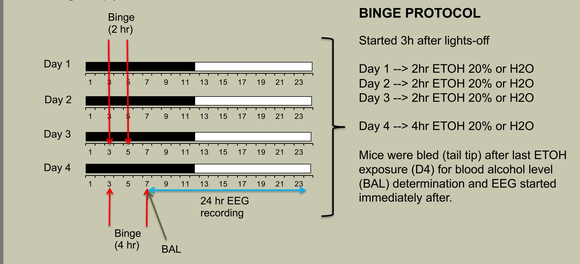
Previous studies from our laboratory showed that C57BL/6J mice exposed to chronic intermittent ethanol vapor and two bottle choice procedure, had reduced slow wave sleep (SWS) four days into withdrawal as well as a decrease in the power density of slow waves, suggesting disruptions in both the amount and quality of sleep (Huitron-Resendiz et al., 2018).

Binge drinking is also characterized by sleep abnormalities and alterations in sleep homeostasis. The objective of this study was to examine the effects of binge alcohol drinking on sleep and sleep homeostasis.

We studied three mouse strains know for high levels of ethanol consumption: C57BL/6J inbred mice, cHAP mice that have been selectively bred for high levels of alcohol drinking in a continuous access two bottle choice procedure, and replicate 1 of High Drinking-in-the-Dark (HDID-1) mice that have been selectively bred for reaching high blood alcohol levels in a limited access procedure.

Materials and Methods

Experiment 1. Male and female C57BL/6J, cHAP and HDID-1 mice were surgically implanted with a standard set of stainless-steel electrodes placed in the frontal and parietal bone for chronic EEG recordings. Following recovery, the mice were given access to alcohol or water under the following drinking-in-the-dark (DID) protocol (7-10 mice/group):



BINGE PROTOCOL

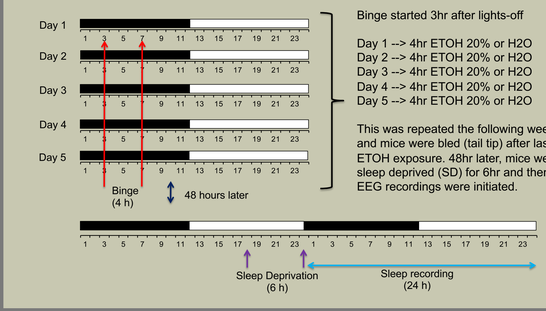
Started 3h after lights-off

Day 1 --> 2hr ETOH 20% or H2O
Day 2 --> 2hr ETOH 20% or H2O
Day 3 --> 2hr ETOH 20% or H2O

Day 4 --> 4hr ETOH 20% or H2O

Mice were bled (tail tip) after last ETOH exposure (D4) for blood alcohol level (BAL) determination and EEG started immediately after.

Experiment 2. Twenty-one days after Experiment 1, the same mice were exposed to the following extended DID protocol to examine possible alterations in the sleep homeostasis:



BINGE + SLEEP DEPRIVATION PROTOCOL

Binge started 3hr after lights-off

Day 1 --> 4hr ETOH 20% or H2O
Day 2 --> 4hr ETOH 20% or H2O
Day 3 --> 4hr ETOH 20% or H2O
Day 4 --> 4hr ETOH 20% or H2O
Day 5 --> 4hr ETOH 20% or H2O

This was repeated the following week and mice were bled (tail tip) after last ETOH exposure. 48hr later, mice were sleep deprived (SD) for 6hr and then EEG recordings were initiated.

Results. Experiment 1

A, Blood alcohol levels on the final day of DID (binge). B, Change in SWS (min) in C57BL/6J, cHAP and HDID mice across 17 hours post-binge. C, Time course of Slow-Wave-Activity changes (hourly averages of delta power, 0.75-4.0 Hz), recorded during slow wave sleep. SWA is considered an index of sleep homeostasis (Borbely et al., 1984). Note that SWA was reduced in female cHAP female mice and to lesser extent male and female HDID mice exposed to DID, suggesting that binge ethanol disrupted sleep homeostasis. Lines connect mean values (+/- S.E.M.), n = 7-10/group, ⁎ $p < 0.05$

Results. Experiment 2

D, Blood alcohol levels on the final day of DID (binge). E, Change in SWS (min) 82 hours post-binge drinking and post-6hours of sleep deprivation (SD) in C57BL/6J, cHAP and HDID mice. F, Time course of SWA changes (hourly averages of delta power, 0.75-4.0 Hz), recorded during slow wave sleep. Note that SWA was reduced in female cHAP and HDID mice with previous binge experience. These results confirm that binge drinking can alter sleep homeostasis. Lines connect mean values (+/- S.E.M.), n = 7-10/group, ⁎ $p < 0.05$

Conclusion

Decreased sleep homeostasis was observed in groups of mice that drank enough ethanol to result in blood alcohol levels of >120 mg/dl in the drinking-in-the-dark procedure. These results, especially those of Experiment 2 in which EEG was recorded 82 hr post final DID episode, suggest that binge drinking can disrupt sleep homeostasis and, thus, decrease sleep quality.

Acknowledgements

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