A Step Toward Solving the Sleep/Pain Puzzle

Commentary on Tang et al. Deciphering the temporal link between pain and sleep in a heterogeneous chronic pain patient sample: a multilevel daily process study. SLEEP 2012;35:675-687.

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Nearly half of individuals reporting insomnia symptoms also report chronic pain.[1] The nature of the likely reciprocal interaction between sleep quality and pain perception is intuitively obvious and of considerable intellectual and clinical importance. However, the intuitively obvious is not always supported by the data, and this hypothetical interactive relationship between insomnia and pain is apparently complex, as our understanding of it continues to evolve.[2] Population-based studies have provided support for such a relationship, but support from laboratory and clinical studies, while suggestive, is mixed. In this issue of *SLEEP*, Tang and colleagues[3] provide us with important insights into this intricate relationship, through their elegant parsing of the potential temporal links between sleep and pain.

Tang et al. report a daily process study of a clinical sample of heterogeneous chronic pain patients with comorbid insomnia. They collected one-week electronic diary data of patients' self-reported sleep quality and efficiency, and ratings of pain, mood, and arousal at multiple times during the day. Actigraphic data were also collected. Their multilevel modeling analytic approach examined the temporal link between sleep and pain as well as the potential impact of mood and pre-sleep arousal. Tang and colleagues found that, while pre-sleep pain did not predict subsequent sleep quality, cognitive arousal did. Conversely, sleep quality predicted next day pain, although only during the first half of the day.

Tang et al. report several key findings. Their finding that sleep predicts next day pain while pre-sleep pain fails to predict subsequent sleep is not completely novel,[4] but it is important because it contradicts what seems a common-sense relationship. Their second key observation, that pre-sleep cognitive arousal rather than pain is predictive of subsequent sleep quality is important, not only because such arousal may have served as a "surrogate" for pain per se in previous studies, but also because of its implications for the hyperarousal theory of insomnia.[5]

The study of Tang et al.[3] had a number of strengths, particularly the measurement of both diary and actigraphic sleep, and multiple daily measures of pain, mood, and arousal across the one-week assessment period. The measurement of depression and anxiety, and cognitive and physiological arousal, in addi-

tion to pain, allowed the authors to examine these variables as potential predictors of sleep quality. Depression and especially cognitive arousal were predictors of subsequent sleep quality, even though pre-sleep pain was not. This methodology also allowed the authors to examine sleep quality relationships not simply with daytime pain, but specifically with pain in both the first and second halves of the day. Further, the availability of actigraphic data allowed the authors to conduct a post hoc analysis of daytime activity that supported their conjecture that a night of good sleep quality might be followed by increased daytime activity. Actigraphic data also allowed for a comparison of both subjective and objective measures of sleep quality and the now common finding that different sleep quality measures had different associations with pain. Clearly, the study protocol contained a number of important components that might best be incorporated into future studies examining sleep/pain relationships.

The counterintuitive finding reported by Tang et al.—that while measures of sleep quality predict next day pain, pre-sleep pain does not predict sleep quality—was also recently reported in a very different chronic pain population. While Tang et al. reported their findings drawn from a sample consisting principally of middle-aged women with both chronic pain and insomnia, Lewandowski et al.[4] reported similar findings in a group of adolescents, predominantly female, with chronic pain but without an insomnia complaint. Comparison of the results of these two studies is informative, as it illustrates a concern recognized by Tang and colleagues in their introduction, *"the… pain-sleep relationship… varies according to the characteristics of the sample (… adults vs. adolescents), presence or types of pain… and method of assessment (subjective vs. objective)."*[3]

Both of these high-quality studies were consistent in their findings that pre-sleep pain did not predict subsequent sleep. However, while Tang et al. reported that subjective sleep quality, as opposed to subjective or actigraphic sleep efficiency, was the most reliable predictor of next-day pain, Lewandowski et al.[4] using similar data collection and analytic methods to Tang and colleagues, found that actigraphic total sleep time and wake after sleep onset predicted next-day pain, while actigraphic sleep efficiency and subjective sleep quality did not. Interestingly, the overall pattern of results is similar, i.e., measures of sleep predict next-day pain while pre-sleep pain does not predict sleep; however, the exact measures of sleep that are the predictors of pain differ considerably between the two studies, suggesting that any complete answer to the sleep-pain relationship will require more investigation.

Accurately fleshing out the interaction of sleep and pain will be challenging. Valid and reliable measurement of both

perceived pain and sleep quality is difficult at best. As noted, sleep-pain relationships, which may vary with study sample characteristics and even within samples may be further complicated by nociceptive stimuli that may wax and wane over time and individual differences in pain perception. Only well-designed observational and experimental studies, employing carefully defined subject samples and utilizing careful assessments of sleep, pain, and related factors, will eventually delineate this complex relationship.

Sleep and pain interactions, regardless of their exact nature, have important scientific and clinical implications. The brain mechanisms that form the substrate for such interactions are only beginning to be delineated.[6] Improving sleep quality in chronic, and perhaps even acute, pain populations may ultimately help control pain.[7] Tang and colleagues[3] have helped clarify the relationship between sleep and pain, if only by demonstrating its likely true complexity. Their elegant methodology, measurement of important potential co-factors, which may influence any sleep-pain relationship, and provocative findings, form an important move forward in our understanding. However, as they recognize in their conclusion, *"the daily pain-sleep-pain relationship may systematically vary between individuals and between… diagnoses."*[3] Another firm and informative step towards a full understanding of the interrelationship of sleep and pain has been taken, but most of this important journey remains ahead of us.

DISCLOSURE STATEMENT

Dr. Vitiello has indicated no financial conflicts of interest.

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