British Journal of Anaesthesia **104 (5):** 619–27 (2010)
doi:10.1093/bja/aeq063 Advance Access publication March 30, 2010

BJA

Effect of sleep deprivation on labour epidural catheter placement

M. A. Hayter[1]*, Z. Friedman[2], R. Katznelson[3], J. G. Hanlon[1], B. Borges[2] and V. N. Naik[4]

[1]Department of Anesthesiology, St Michael's Hospital, University of Toronto, 30 Bond St., Toronto, ON, Canada M5B 1W8. [2]Department of Anesthesiology, Mount Sinai Hospital, University of Toronto, Ontario, Canada. [3]Department of Anesthesiology, University Health Network, University of Toronto, Ontario, Canada. [4]Department of Anesthesiology, The Ottawa Hospital, University of Ottawa, Ottawa, Canada

**Corresponding author. E-mail: megan.hayter@utoronto.ca*

Background. Epidural catheter insertion for labour analgesia is an invasive procedure with potential serious complications, often performed by a sleep-deprived clinician. The aim of this study was to examine the effects of sleep deprivation on physicians of variable levels of experience performing this procedural skill in the clinical setting.

Methods. After institutional review board approval, anaesthetists of three levels of experience were recruited: novice residents (<30 epidurals, $n=9$), experienced residents (>100 epidurals, $n=8$), and attending anaesthetists (>500 epidurals, $n=12$). All participants were measured twice, rested and sleep deprived in a random order while performing a labour epidural for analgesia. Our primary outcome measures were scores achieved on the Imperial College Surgical Assessment Device (ICSAD) (measuring path length, number of movements, and time), task-specific checklist (CL), and global rating scale (GRS). Sleep deprivation was documented by the ActiGraph™ and Epworth sleepiness scale.

Results. Subjects were adequately sleep deprived for their sleep deprivation observation. Data were analysed with a two-way mixed design analysis of variance. No significant difference in the effect of sleep deprivation on performance was detected between the groups on the ICSAD measures of movement ($P=0.86$), path length ($P=0.79$), and time ($P=0.80$), or for the CL ($P=0.65$), and GRS ($P=0.86$).

Conclusions. The performance of this procedural skill in a clinical setting does not seem to be affected by sleep deprivation irrespective of the level of experience.

Br J Anaesth 2010; **104**: 619–27

Keywords: anaesthetic techniques, epidural; complications, sleep deprivation; technical skills

Accepted for publication: February 22, 2010

Sleep deprivation due to extended work hours and circadian rhythm disruption has been called the Achilles' heel of the medical profession.[1] In the USA, the highly publicized death of an 18-yr-old female, which was partially attributed to trainee fatigue,[2] led New York State to initiate an 80 h work week. The proposed relationship between fatigue and medical error has been the impetus behind the legislation limiting resident and physician work hours. In 2002, the Accreditation Council for Graduate Medical Education mandated an 80 h work week nationally for residents in the USA as part of national guidelines regulating duty hours for all physicians in training.[3] Within Canada, there is currently no national work hour restriction legislation in place for trainees or practicing physicians. Opponents to the work hour change have focused on loss of clinical exposure, decreased practical training opportunities, and decreased continuity of patient care.

There are a variety of industries in which the effects of fatigue on human performance are well documented (i.e. transportation and aviation).[4 5] Laboratory studies of physicians have supported the results from other industries indicating the adverse effects of sleep deprivation on performance. However, when the effects of sleep deprivation on individual physicians are investigated in either the simulated or clinical environment, the results are inconsistent with the epidemiological data. Possible explanation for this discrepancy includes individual variability in sleep need and performance, and inadequately powered studies.

Literature on the effects of sleep deprivation anaesthetists is primarily from survey reports and simulation studies.[6–11] Survey reports of anaesthetists have revealed

that many practitioners perceive fatigue as a major risk for patient safety.[12] Data collected from critical incident reports in Australia from 1987 to 1997 found that fatigue was a causal factor in 3% of critical incidents.[13] Early simulation studies of anaesthetists using psychomotor reaction time tasks and simulated driving tasks have revealed inconsistent results.[14 15] A recent study set in a realistic simulation environment studied the effects of acute sleep deprivation on resident clinical and psychomotor performance, subjective and objective sleepiness, and mood.[11] The results demonstrated that although psychomotor measures of performance and mood were impaired, clinical performance remained unaffected. The connection between these artificial tasks and high-stakes clinical situations has not yet been established. In order to elucidate the effects that sleep deprivation has on individual performance, studies set in the clinical environment are required.

The purpose of this study was to investigate the effects that sleep deprivation has on the clinically relevant complex task of labour epidural insertion, and determine whether physician experience attenuates these effects. Labour epidural catheter insertion is a complex procedural skill that anaesthesia residents must master during their training. Epidural needle and catheter placement require a multitude of procedural skill components, all of which need to be meticulously performed with a high degree of attention.[16] This study compared performance of labour epidural placement within each group (rested and sleep deprived), and between the groups (different levels of experience) using a quantitative hand motion analysis device (Imperial College Surgical Assessment Device, ICSAD), a previously validated checklist (CL),[16] and a global rating scale (GRS).[17] This study represents a first report comparing the effects of sleep deprivation and level of experience on anaesthetists' ability to perform a complex procedural skill set in the clinical setting.

Methods

After institutional review board approval (Mount Sinai Hospital and St Michael's Hospital, Toronto, Canada) and informed consent, residents and attending anaesthetists were recruited to participate in the study. Three groups of physician subjects were recruited: novice residents, experienced residents, and attending anaesthetists. Physicians were observed in two states: rested and sleep deprived.

Work hours of attending and resident anaesthetists at the two participating institutions were similar. A normal day shift begins at 08:00 h and terminates at ~17:00 h. A night call shift begins at 17:00 h and ends at 08:00 h. Night call at the two institutions is typically busy requiring both the resident and the attending anaesthetist to be awake for the majority of the night. This was quantified by having the subjects wear an ActiGraph™. At the two participating institutions, anaesthetists do not work when they are post call.

The novice group consisted of anaesthesia residents who had performed <30 labour epidurals independently at one of the participating institutions. The current standard of care at our institutions is that novice residents receive didactic lectures on labour epidural insertion, then observe five labour epidural insertions, and then perform five labour epidurals with a gloved attending anaesthetist observing. The residents then perform the task independently. The experienced resident group was composed of anaesthesia residents who had performed more than 100 epidurals. This was described in the literature as a level of experience in which the learning curve for epidural catheter insertion reaches a plateau.[18–20] The attending anaesthetists were obstetrical anaesthetists at Mount Sinai Hospital, Toronto, Canada, and had performed well more than 500 epidurals. There were no exclusion criteria for physician subjects.

Informed consent was obtained from all parturients before participation. In order to control for technical difficulty, parturients were excluded from the study if they were morbidly obese (BMI >35), possessed spinal deformities, or if they were unable to sit relatively motionless for the procedure due to excessive labour pain.

During a 4 month period, all subjects were observed once in each state: rested and sleep deprived. For the labour epidural, parturients were positioned sitting up. A midline approach was used between the L2 and L4 interspaces. An Arrow® 17 G epidural needle and catheter set was used at both hospital sites (Arrow, Reading, PA, USA). In order to control for fatigue and workload factors, rested measures were performed between 08:00 h and 12:00 h during a labour and delivery day shift. Sleep-deprived measures were recorded between 04:30 h and 08:00 h during a night on-call labour and delivery shift. A night on-call labour and delivery shift is from 17:00 h to 08:00 h. Subjects were asked to refrain from drinking caffeine after midnight before their sleep-deprived measure. In order to minimize testing effect, the order of the sleep state observations was randomized.

Sleep deprivation was measured by the Epworth sleepiness scale (ESS). Immediately before completing the labour epidural in both sleep states, subjects completed the ESS as part of a patient characteristic questionnaire (Appendix 1). The ESS is a validated subjective measure of a subject's perceived general daytime sleepiness, and asks respondents to rate their likelihood of falling asleep in eight common scenarios on a three-point scale. Higher ESS scores reflect a greater degree of sleepiness.[21 22]

Before their sleep-deprived observation, sleep deficit was also confirmed by number of hours slept using the quantitative ActiGraph™ (ActiGraph, Pensacola, FL, USA). ActiGraph™ data were analysed with ActiLife™ Software (ActiGraph). Subjects were given the ActiGraph™ at the initiation of their on-call shift and were instructed to wear it on their wrist at all times and only remove it for sterile procedures. The data from the