Research letters

Effect of sleep deprivation on surgeons' dexterity on laparoscopy simulator

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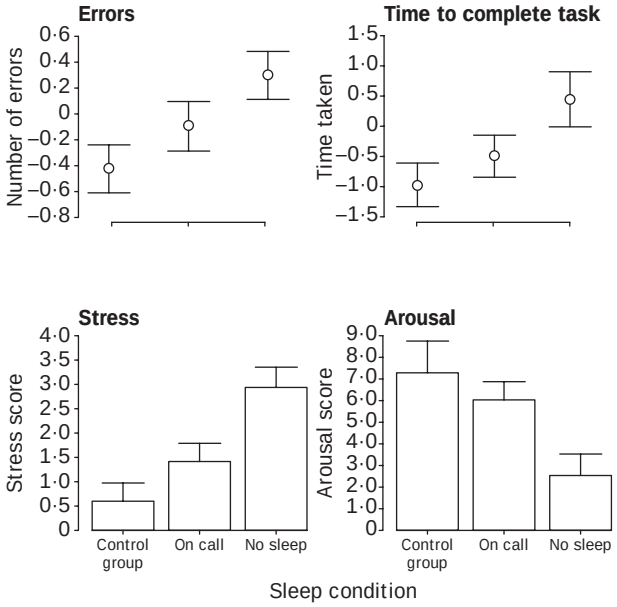
Sleep deprivation impairs cognitive performance;[1] wakefulness for 24 h is equivalent to a blood alcohol level of 0·10%,[2] which is above the legal driving limit in the UK. Although surgeons commonly operate after a disturbed night's sleep, the effect of lack of sleep on surgical dexterity has been difficult to quantify because objective measurements of psychomotor skills are not easy to validate. The psychomotor skills necessary for laparoscopic surgery are especially demanding and several virtual-reality simulators are now available to teach surgeons laparoscopic surgery techniques. We aimed to quantify the effect of sleep deprivation on surgeons' laparoscopic skills with a virtual-reality laparoscopic surgery simulator.

We measured dexterity with the Imperial College Surgical Assessment Device (ICSAD), which generates objective measurements of performance by tracking the movement of surgical instruments. The x, y, z position data are passed through a fourth-order 1·5 Hz Butterworth filter and then processed to calculate the number of times the instrument missed the targets (errors) and the time taken for each exercise. These objective measurements of performance have been previously validated.[3] We tested surgical skills with a virtual-reality laparoscopic surgery simulator (MIST VR, Ethicon, UK). The task in the simulator had been modelled on techniques used during a laparoscopic cholecystectomy and involved a complex two-handed skill with precise use of a foot pedal to simulate electrocoagulation of virtual targets.



Mean (SE) effect of sleep conditions

All the participants had been pre-trained on the simulator. We studied six surgeons in training (median age 30 years [range 26–33]; median 5 years [range 2–9]) since qualification who were tested on six different nights, with 1-week intervals. Each assessment consisted of 20 repetitions of the task in the evening (1700–1800 h) and an identical test the following morning (0800–0900 h) after one of three conditions: an undisturbed night (n=12), a sham night on call (disturbed at 0000 h, 0300 h, and 0600 h, n=12), and a night with no sleep (n=12). Practice effects were controlled by a Latin square design. Participants also completed a standard stress and arousal questionnaire after each test.[4]

Repeated-measures ANOVA for a Latin square showed a significant linear trend across the sleep conditions compared with baseline for total time ($F[1, 20]=8·40$, $p=0·009$) and error score ($F[1, 20]=8·49$, $p=0·009$ figure), with a non-significant non-linear trend. Surgeons awake all night made 20% more errors and took 14% longer to complete the tasks than those who had had a full night's sleep (denominator as overall mean for errors=3·48 and for time=10·1 s) and also showed increased stress and decreased arousal ($F[1, 20]=17·52$, $p=0·001$; $F[1, 20]=80·08$, $p=0·001$, respectively; figure), which paralleled the decrease in operative dexterity. Stress and arousal correlated ($r=–0·640$, $n=72$, $p<0·001$). The decline in performance remained significant after arousal was taken into account as a covariate ($p=0·011$), but not after stress was used as a covariate ($p=0·105$), suggesting that sleep deprivation mediates its effect via increased stress rather than decreased arousal.

Although these changes after sleep deprivation might be seen as potentially dangerous for actual surgical practice, only cognitive and simulated tasks rather than real clinical performance may be affected.[5] Nevertheless, our findings suggest that lack of sleep may affect performance in the operating theatre.

1 Wesnes K, Walker M, Walker L, et al. Cognitive performance and mood after a weekend on call in a surgical unit. *Br J Surg* 1997; **84:** 493–95.

2 Dawson D, Reid K. Fatigue, alcohol and performance impairment. *Nature* 1997; **388:** 235.

3 Taffinder N, Sutton C, Fishwick RJ, McManus IC, Darzi A. Validation of virtual reality to teach and assess psychomotor skills in laparoscopic surgery. In: Westwood J, Hoffman H, Stredney D, Weghorst S, eds. Technology and informatics 50: proceedings of medicine meets virtual reality 6—1998 Jan 28–31; San Diego, USA. Amsterdam: IOS Press. 1998 124–30.

4 King MG, Burrows BG, Stanley GV. Measurement of stress and arousal: validation of the stress/arousal adjective checklist. *Br J Psychol* 1983; **74:** 473–79.

5 Editorial. The dangers of not going to bed. *Lancet* 1989; **21:** 138–39.

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