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The Effect of Day and Night Shift Working on the Attention and Anxiety Levels of Anesthesia Residents

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SUMMARY: The Effect of Day and Night Shift Working on the Attention and Anxiety Levels of Anesthesia Residents

Objective: To evaluate the attention, learning and memory related cognitive functions after 12-hour day versus night shift-work in anaesthesia residents.

Method: Fifteen residents working on the day shift and 18 working on the night shift volunteered. All were interviewed with the Rey Auditory Verbal Learning Test (AVLT), Visual Aural Digit Span Test (VADST), and State Trait Anxiety Inventory (STAI) before and after the shifts. Residents' self-evaluations of their fatigue, stress, sleep quality and duration of sleep were sought.

Results: The two groups were similar regarding age, gender, attention, fatigue, stress, affection, sleep quality and duration of sleep. The number of words learned in the first trial of the Rey AVLT decreased after the shifts in both groups. Before the night shift the word list could be learned more effectively and with fewer trials compared to the pre-day shift. The learning deteriorated, and repetitions and forgotten words increased after the night shift. The aural oral, aural written and visual written subtest scores deteriorated after the night shift. State anxiety levels did not differ between the night and day shift groups or before and after the shifts.

Conclusion: The cognitive functions of residents may be impaired after the night shift. We think that close supervision of residents and provision of more rest for them during night shifts would be beneficial in decreasing their errors, which may affect patients.

Key Words: Shift-work, sleep disorder, anxiety, cognitive manifestations

INTRODUCTION

Long and variable working hours are common for physicians during their careers. These conditions lead to inadequate sleep, disorders in daily activities and fatigue (Howard et al. 2002).

It is controversial how sleeplessness affects performances of physicians (Howard et al. 2003). Anesthesiologists generally work in long shifts which lead to severe and chronic sleep loss and sleep disorders. During shifts the burden of work and need to sleep both may lead to reduction in attention, disorders in judgment and delays in decision making. Anesthesia residents were reported to be sleepy like narcolepsy patients during daytime. It was emphasized that this condition did not improve after sleeping, sleeps were divided many times and there was reduction in deep sleeping (Howard et al. 2003).

A significant relationship was determined between night long sleeplessness, reduction in attention and performance decrease in cognitive functions (Leproult et al. 2003). If healthy adults sleep less than mean 5 hours a night, their cognitive performances begin to decrease. As a consequence of both short and long term sleep disorders, expressing and problem solving abilities deteriorate. Learning skills may decrease to 50% in sleep disorders (Veasey el al. 2002).

In this study, assessment of changes in cognitive functions like attention, memory, learning or remembering with event specific and continuous anxiety levels in anesthesia residents who work in 12 hours' day or night shifts is aimed.

METHOD

Subjects

Volunteer anesthesia residents who were between 24-40 years old and used to work in 12 hours' shifts were included in this study following ethics committee approval. Working hours were 08-20 for day shift and 20-08 for night shift for five days. These working hours were regular shift periods and were not changed for study purposes. Exclusion criteria were pregnancy, presence of psychiatric disorders and current drug use for sleep disorders. None of the residents had psychiatric disorder or used any drug for sleep disorders, but one of them was pregnant and she was excluded from the study.

Procedure

A questionnaire was administered to all subjects before and after shifts in the first day of 5 days' period. Cognitive functions, anxiety inventory, subjective thoughts about tiredness, stress, sleep duration and quality were evaluated in that questionnaire. These tests were performed by experts. For time sparing purposes, performance order of the tests was as the following: Auditory Verbal Learning Test, Visual Aural Digit Span Test, State Trait Anxiety Inventory and the questionnaire.

Measurement Instruments

State Trait Anxiety Inventory (STAI)

State-Trait Anxiety Inventory was developed by Spielberger (1970) in order to determine event specific and continuous anxiety levels separately. It is a self evaluation questionnaire made up of short expressions. It was adapted to Turkish by Öner and LeCompte (1985).

STAI includes two separate subscales which constitutes totally 40 clauses. State anxiety scale necessitates definition how someone feels in certain conditions in a certain time period with considering thoughts about current condition. We administered state anxiety scale before and after shifts. Continuous anxiety scale which evaluates general feelings administered only before shifts.

Evaluation of Cognitive Functions

Changes in cognitive functions before and after shifts in day and night workers were evaluated with Auditory Verbal Learning Test and Visual Aural Digit Span Test. Both tests were administered to both groups before and after shifts.

Auditory Verbal Learning Test (AVLT)

It is a verb list learning test which was developed by Rey (1964). It may differentiate many parameters associated with memory: first, momentary memory; second, learning and informative process; and third, keep in mind, recall and remembrance process. Remembrance is evaluated in two types; delayed spontaneous and delayed recognizing remembrance.

This test includes unrelated 15 words. These words are read to the subject with one second intervals and the subject is asked to repeat remembered ones. This procedure aims to evaluate instant memory and attention continuity. Total number of right words is recorded as instant memory score of the subject. Then the same list is read to the subject nine times more, and the subject is asked to repeat remembered words each time. By this way, learning ability of the subject is evaluated. For whatever reason if the test loses its validity, there is a second list of words present. In our study, we administered the second list at the end of the shifts in order to decrease the effect of learning.

Turkish validity and reliability study of AVLT was performed by Öktem (1992). It was used in patients with variable neurological disorders in order to evaluate cognitive functions (Demir et al. 2000).

Visual Aural Digit Span Test (VADST)

VADST was developed by Koppitz (1970) in order to differentiate learning disorders of children. Turkish standardization study was performed by Karakaş and colleagues (2002). It is not only beneficial in evaluating awareness, attention and concentration, but short term memory as well. It includes four subtests: Aural Verbal Subtest, Visual Verbal Subtest, Aural Written Subtest and Visual Written Subtest.

Test administrator begins with digit span number three and shows or reads digits with one second intervals. Then the subject is asked to repeat the digits verbally or written in the same order without grouping. At the end, longest span without faults is the point of the subject. We used different spans before and after shifts in order to decrease the effect of learning.

Questionnaire

A questionnaire was applied to the subjects be-

TABLE 1. Demographic data of subjects

	Daytime shift (n=15)	Night shift (n=18)
Age (years) (Mean±SD)*	29±2.5	29±2.4
Female/Male (n)	10/5	14/4
Duration of residency (months) (Mean±SD)**	32±18	28±19

p>0.05 inter groups' comparison, *t=0.282, **t=0.583, **degree of unrestrictedness: 31

fore and after shifts besides tests. Before the shifts alcohol consumption within last 24 hours, tiredness, readiness for work load, the duration, quality and division of sleep are asked. At the end of the shifts work load, stress level, tiredness and presence of work related faults are asked.

Statistical Method

SPSS 10.0 software was used in statistical analyses. Regular distribution of data was verified via Kolmogorov-Smirnov test. Differences between day and night groups in AVLT, VADST and STAI results which showed regular distribution and similar variance were evaluated with variance analysis of repeated measurements (Greenhouse-Geisser method). In order to evaluate attention changes between day and night shifts in the first day of working, matched t-test was used. Two groups were compared with chi-square test for categorical data (gender, questioning of subjective experiences) and t-test for digital data. Correlation between anxiety scores and other parameters was evaluated with Pearson analysis. Statistical significance level was considered as $p<0.05$.

FINDINGS

There were totally 42 anesthesia residents and 15 residents from day shift and 18 residents from night shift were included in the study. Demographic data of the subjects are presented in Table-1. Both groups were similar for age, gender and residency durations. Assessments of questionnaires before and after shifts may be seen in Table-2. Both groups were similar for variables present in Table-2. None of the residents consumed alcohol within the last 24 hours before shift-work.

Test results of residents before and after shifts may be seen in Table-3. In Auditory Verbal Learning Test number of words remembered after first repeat and total number of remembered words decreased significantly in both groups after shifts ($p<0.05$). Night shift workers learned word list with less repeat (complete learning point) and more successfully (weighted learning point) before shifts, but the impairment in learning was more prominent in this group after shifts ($p<0.05$, in and between groups). Repeats and number of words forgotten (losses) did not differ after day shifts, but increased after night shifts ($p<0.05$, in and between groups).

Aural Verbal, Aural Written and Visual Written subtests of Visual Aural Digit Span Test impaired after night shifts. This difference was not present in day shift workers ($p<0.05$, comparison in night shift group and between groups).

Event specific and continuous anxiety levels were similar in groups. There was not any significant correlation between continuous anxiety points, duration of residency and age according to Pearson analysis. There was a reverse relation between before shift event specific anxiety point and AVLT recognizing remembrance point (r^2=-0.436, p=0.01). Moreover, there was another reverse relation between after shift event specific anxiety point and VADST visual written subtest point (r^2=-0.399, p=0.02). When junior (duration of residency<2 years) and senior (duration of residency>2 years) residents were compared, there was not any difference other than age and duration of residency variables.

DISCUSSION

Performances of anesthesia and surgery residents after working hours and duties has been a focus of interest and a subject of many studies and simulations (Murray and Dodds 2003, Weinger and Englund 1990). It was considered that espe-

TABLE 2. Characteristics of volunteers from daytime and night shifts

	Daytime shift (n=15)	Night shift (n=18)	p
At the beginning of the shift			
Tiredness	8	10	0.588
Readiness	14	16	0.570
Sleeping duration within last 24 hours*	5.9±1.31	5.19±2.31	0.302
Good sleeping quality	13	14	0.423
Sleep separation	10	13	0.512
At the end of the shift			
Self reporting work load	11	10	0.245
Self reporting work stress	8	8	0.437
Self reporting tiredness	14	17	0.710
Self reporting faults	0	1	0.545
Continuous anxiety points#	42.93±8.59	45.56±5.38	0.295

*t-test (t=1.049), degree of unrestrictedness=31
#t-test (t=-1.069), degree of unrestrictedness=31
Other data are analyzed via chi-square.

cially shift work (working during regular sleeping hours and able to sleep in inappropriate periods of day) might impair performance and lead to cognitive and affective disorders (Akıncı et al. 2003, Taffinder et al. 1998). In this study we evaluated changes in cognitive functions (attention, learning, memory) and anxiety levels after shift-work in anesthesia residents who worked 12 hours during daytime or night.

There was no difference in anxiety levels of day or night workers. Two groups were similar according to assessment of work stress and load, as well. These interesting findings indicated that residents considered work load and stress as equal during daytime or night. Similarity of both groups according to readiness sensation before shifts or level of tiredness and anxiety indicated the same point; work load of day or night shifts were perceived equally.

Sleeping durations of residents were reported as mean 5-6 hours and there was not any difference between two groups. Sleep separation was present in both groups. There was not any self reported fault in daytime shift group, but one fault was present in night shift group. Consequences of sleeplessness are some problems and medical faults. It was reported that 31% of resident faults resulted with death of the patient (Wu et al. 1991). The reason for relatively low number of resident faults in our study may be due to supervision of a senior specialist.

When cognitive functions were taken into consideration, shift beginning points were higher than after shift points. This meant that work load and tiredness impaired attention and memory functions. There are some other reports which emphasize the same finding (Strorer et al. 1989, Jaques et al. 1990, Samkoff and Jaques 1991).

In our study, complete and weighted learning points of night workers were higher (more successful) before shifts, but the numbers of forgotten or repeated words were greater than day workers after shifts. These results indicated that night workers were more dynamic at the beginning of their shifts, but the degree of impairment in cognitive functions was more prominent. As the level of work load and tiredness was reported as similar between day and night work, this impairment might be a consequence of changes in sleeping rhythm (sleeping daytime instead of night). If an adult who normally sleeps at night is deprived of this habit, there may be concentration disorders during this time interval. Sleep deprivation has considerable effects on affect and cognitive performance. Leonard and

TABLE 3. Before and after shift test results of day and night workers

	Daytime shift (n=15)		Night shift (n=18)	
	Before	After	Before	After
Auditory Verbal Learning Test				
Momentary memory score	8.67±2.16	7.13±2.17#	9.28±2.40	6.94±1.86#
Complete learning	4.87±1.64	5.67±2.093#	3.44±0.86*	5.82±2.16#
Total learning points	132.6±12.5	125.47±12.9#	138.83±5.54	125.44±14.4#
Learning rate	5.93±2.37	7.73±2.19#	5.67±2.47	7.78±2.02#
Weighted learning points	11.96±2.53	10.08±2.53#	13.92±2.86*	9.77±2.20#
Repeats	5.07±3.71	6.13±5.03	3.50±4.31	10.67±10.04#
Number of words learned at last attempt	14.6±1.55	14.8±0.77	15±0	14.72±1.18
Lost	1.53±1.81	2.2±2.01	1.72±1.45	3.28±
Recognizing remembrance	14.53±0.74	14.4±1.12	14.72±0.67	14.72±0.57
Visual Aural Digit Span Test				
Aural-Verbal points	7.33±1.23	7±0.93	7.28±1.02	6.61±1.29#
Aural-Written points	6.73±0.88	7.27±1.22	7.44±1.20	6.83±1.25#
Visual-Verbal points	6.93±0.96	6.53±1.06	7.33±124	6. 94±1.39
Visual-Written points	7.47±0.99	7.40±1.06	7.83±1.04	6.89±1.37#
Event specific anxiety points	41.2±10.07	41.47±9.51	41.78±9.88	44.5±9.02

*$p<0.05$ (comparison of daytime and night workers before shifts)
#$p<0.05$ (in group comparisons were performed with repeating measurements variance analysis)

colleagues evaluated physical condition and cognitive functions in 16 residents and found that both parameters were affected with sleep deprivation. Similarly, it was shown that performance and cognitive functions of residents impaired after duties in controlled, prospective studies (Smith-Coggins et al. 1994, Halbach et al. 2003).

When performed with 12 hours' intervals, word repeating or digit span test results may be influenced by learning factor. This influence can not be changed by using different series, because gaining experience may improve learning. But in our study which we used completely different series, we did not find any effect of learning like being more successful in second test.

In VADST, which was another test to determine cognitive performance, end of night shift points were lower than beginning in all three subgroups. This test evaluates attention and high cortical functions. Lower points at the end of night shifts might be an indicator of fault tendency.

There were reverse relationships between points of before shift state anxiety and AVLT recalling memory or after shift state anxiety and VADST visual written subtest. These findings were concluded as higher anxiety levels might lead to greater impairment in cognitive functions. It may be proposed that, with a greater number of subjects, a more powerful relationship between anxiety points and cognitive functions can be shown.

There were some limitations of our study. It was not blind, because all subjects were informed about the study in order to provide voluntarily participation. As cognitive and affective tests necessitate a relatively long time, total number of subjects is low. Only 33 of 41 residents who fulfilled the inclusion criteria accepted to participate. Moreover, we think that to assess affectivity and anxiety of the participants completely was not so easy and this was another limitation of us. We did not take into consideration sleeping forms and factors influencing these forms like menstruation or other daily things.

As a result, we found that cognitive functions of residents who worked in 12 hours' long day or night shifts impaired at the end of working periods. This impairment was more prominent after night shifts. Because of relatively high risk for faults, night shift worker residents should be monitored closely.

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