

The effect of night light on delirium occurrence in post-operative cardiac patients.

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Abstract: The aim of this paper is to identify the effect of night light on delirium occurrence in post-operative cardiac patients. Design: A randomized prospective observational study.Method. 60 patients (25 in the experimental group, 35 in routine group) who underwent cardiac surgery from 1/ May 2016 to 30 / December 2016 and met inclusion criteria were enrolled. The patients were sorted randomly to sleep with or without eye masks during the first three nights. The Chinese version of Richards-Campbell Sleep Questionnaire (ROCK) was used to evaluate the subjective sleep quality. The NEECHAM Confusion Scale was used to assess delirium each morning for each patient. Result: Total Mean \pm SD of the overall score of ROCK items in the three nights was 49.05 ± 5.65 in routine group versus 58.73 ± 5.06 in the experimental group (P value <0.001). Total Mean \pm SD of the overall score of the NEECHAM in the three nights was 20.90 ± 1.82 in routine care group versus 23.66 ± 1.613 in experimental group. A dramatic decrease in delirium occurrence in the experimental group versus routine group (P value <0.001).Conclusion: This non-pharmacological nursing intervention as eye mask is efficient for decreasing delirium in the critically ill patient.

Keywords: delirium, sleeping quality, open heart surgery, nursing, Questionnaire, eye mask.

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I. Introduction

The reversible state of sensory and cognitive withdrawal from the external environments is defined as sleep. It is also considered as a complex physiologic and behavioral process that important for survival, recovery, healing, and well-being. Poor sleeping quality is a collective experience of critically ill patients and plentiful after cardiac surgery. Sleep deprivation occur in 60%-80% of post-operative patients immediately, and seem to continue to occur in 39% to 69% of cardiac surgery patients after hospital discharge during the first month (Greve& Pedersen, 2015).Studies focus of ICU survivors mentioned that sleep disturbance was one of the first 3 causes of sensory deprivation during the ICU stay (associated with insertion of endotracheal tube for mechanical ventilation and pain) (Kamdar, Needham, &Collop, 2012).

There are numerous factors which increase the prevalence of sleeping alteration for patients admitted in intensive care areas. Medications, pain, and illness are the primary physiologic factors figured in the literature. The primary psychological factors that contribute to sleep deprivation are Stress and worry. Noise, therapeutic modalities as mechanical ventilation because of ventilator dysynchrony and activities of patient care are environmental factors disrupt sleep in intensive care areas. (Hellström&Willman, 2011)&(Meenen, Meenen, Rooij, &Riet, 2014). The biological markers of the circadian rhythm include melatonin and cortisol. Light exposure result in nocturnal melatonin secretion suppression during night and a severe lack of sleep in intensive care patients. Therefore, light exposure at night is another important environmental sleep disruptor (Hu, Jiang, Chen, et al., 2010).

Delirium in postoperative surgical patients has been mentioned and reported in various groups as patients undergoing orthopedic and cardio-vascular surgery (Meenen et al., 2014). The prevalence of delirium after cardiac surgery has been reported to occur between 16% and 73% of patients; yet, cardiac surgeons, anesthesiologists, intensivists, and nurses may fail to recognize delirium in up to 84% of patients (Evans et al., 2016). There are dangerous adverse hospital outcomes associated with delirium as risk of death that increased to a tenfold and risk of nosocomial complications that increased to a fivefold (O'Neal & Shaw, 2016).

Delirium and sleep alteration relationship has special necessary in the practice of critical setting. Numerous ICU patients, especially patients with old age and/or mechanically ventilated patients are at risk of experiencing both sleep disturbance and delirium. Although the causal association between sleep disturbance and delirium become the focus of research, both conditions participate mechanisms and risk factors and similar symptoms. Anesthesia agents and circadian rhythm disorders and neglect occur with both of the two phenomenons. Recently, many evidence supports that optimizing sleep is a necessary intervention for reducing the prevalence of delirium (Kamdar et al., 2012)&(Makic, Rauwen, Watson, & Poteet, 2014).

Most research did not focus on the effects of ICU noise combined with light factors on patients' physiological and psychological outcomes and focused only on noise reduction (Hu, Jiang, Zeng, Chen, & Zhang, 2010). Because nurses in the critical care areas are the caregivers with the most sustained patient contact in the ICU, they are in a unique position to share in sleep research and base their practice on the results of such research. Nurses play an essential role in improving their patient's sleep and limiting sleep disruption (Dave, Qureshi, & Gopichandran, 2015). Therefore it is critical to find effective nursing interventions to promote sleep in intensive care environment

II. Objectives of trial

- The primary outcome of this trial was to identify the prevalence of delirium in post-operative cardiac patients in response to improving sleep by eye mask.
- The secondary outcome of this trial was to evaluate the outcomes in critically ill patient as mortality, ICU stay.

Hypothesis

- Hypothesis 1: Using eye mask could be beneficial in the prevention of the early onset of intensive care delirium.
- Hypothesis 2: Using eye mask could be beneficial in the improvement of sleeping quality and outcomes of critical patients.

III. Patients and Methods

3.1-Inclusion and exclusion criteria:

- Study participants were recruited and approached for the study from 1/ May 2016 to 30 / December 2016.
- The matching criteria were: (1) age ≥ 18 years; (2) ability of patients to understand the sleep questionnaires and communicate verbally; (3) ICU stay ≥ 48 hours.
- Exclusion criteria were: (1) Psychiatric or neurological disease; (2) Shocked patients and (3) eye disease.
- Seventy-five (75) patients consented to participate in the study and data analyses were carried out on 60 cases (Figure 1)

3.2- Setting:

- The study was conducted at Asyut university cardiac center; postoperative ICU (included an 11-bed).

3.3-Randomization:

- Seventy patients were sorted randomly into one of two groups (experimental group and control group). Randomization was done by using computer generated random numbers and contained in an opaque sealed envelope.

3.4- Intervention:

- Each patient was met by the principal author in the ward of cardiac surgery at the first day of their admission to obtain written informed consent.
- Each patient's demographic related data was collected by using interview questionnaire.
 - American society of anesthesiology physical status classification was collected by the researcher from the medical records of the patients that included: class I: Healthy person, class II: Mild systemic disease, class III: patient with severe systemic disease, class IV: patient with severe systemic disease that is a constant threat to life, V: Moribund patient who is not expected to survive without the operation and

class VI: declared brain-dead patient whose organs are being removed for donor purposes (Daabiss M,2011).

- The routine care group: received the usual care during the nights.
- The experimental group received single use protective eye masks during nocturnal sleep (Flight Eye-masks; Dreaming, Zhuji City, Zhejiang, China). Each patient was assisted by ICU nurses to wear eye mask from 9:00 pm to 7:00 am the next morning.
- Note 1: Some patients refuse to wear eye masks because they feel uncomfortable and anxious if they cannot see anything, therefore they were excluded from the trial.
- Note 2: All Patients in control and intervention groups had an indwelling urinary catheter throughout the postoperative period to minimize the number of sleep interruptions.

3.5- Evaluation

3.5.1- Sleep perception assessment

- The researcher assess the subjective sleep quality at 7:00am each morning during the three consecutive ICU days (first day, second day and third day)bythe Richards-Campbell sleep questionnaire (RCSQ)that recently used by (Dave et al., 2015)(Appendix 1).
- A copy of the questionnaire were completed by each patients each morning of the three ICU days after it was translated to Arabic
- The total score on the RSCQ was calculated by dividing the sum of scores of the items by five. Cronbach's alpha value of the Chinese RCSQ in this study was (0.83) this indicates that the tool has a strong ability to accurately measure the variables.

3.5.2-Assessment of delirium

- The researcher will assess the occurrence of delirium by using Neelon and Champagne Confusion Scale (NEECHAM) that used recently by (Van Rompaey et al., 2008) (Appendix 2).
- The patients included were observed by the researcher for symptoms of delirium during morning during three ICU days (first day, second day and third day).
- The total NEECHAM scale score is the sum of the scores on the three levels.

Ethical consideration:

The study was approved by the Local Research Ethics Committee of College of Nursing and College of Medicine of Assiut University IRB000087400), and registered in ClinicalTrials.gov (NCT02703415). Patients were informed that they at any time could withdraw their consent to participate.

Statistical analysis

All statistical analyses were performed using IBM SPSSStatistics version 20 (SPSS Inc., Chicago, IL, USA). Descriptive statistics for mean, standard deviation and range were used to describe the sample. A coefficient of determination (r^2) was used to determine the correlation between two variables. Significance level $P < 0.05$ was considered statistically significant.

IV. Result

Table (1) shows the frequency distribution of both study groups regarding socio-demographic characteristics and clinical data. There were no obvious differences among both groups regarding age, gender, and medical diagnosis.

Table (2) shows the ischemic time, Cardiopulmonary Bypass time, duration of operation and length of ICU with no considerable difference between both groups except in length of ICU stay (P value < 0.05).

Table three shows Mean \pm SD of ROCK items between the study groups: There was a dramatic difference among the trial groups ($P < 0.05$) in all ROCK items each night. In the routine care group, the Mean \pm SD of the overall score of the ROCK in the first, second and third night was (36.58 \pm 7.41), (50.45 \pm 5.71) and (60.12 \pm 6.58) respectively. While in the experimental group, the Mean \pm SD of the overall score of the ROCK in the first, second and third night was (46.54 \pm 6.97), (60.20 \pm 6.17) and (69.45 \pm 7.83) respectively. There was a considerable changeamong the trial groups ($P < 0.05$) in total ROCK items each night. Regarding the total Mean \pm SD of the overall score of the ROCK in the three nights was 49.05 \pm 5.65 in the routine care group versus 58.73 \pm 5.06 in the experimental group. There was an obvious difference among the trial groups ($P < 0.05$) in mean ROCK through the three night.

Table four shows Mean \pm SD of trial groups related to the overall score of the NEECHAM in the three night: In the routine care group, the Mean \pm SD of the overall score of the NEECHAM in the first ,second and third night was (17.00 \pm 2.3), (21.14 \pm 2.80) and (24.57 \pm 1.66) respectively. While in the experimental group, the Mean \pm SD of the overall score of the NEECHAM in the first, second and third night was (19.60 \pm 1.75), (24.72 \pm 2.37) and (26.08 \pm 1.82) respectively. There was a considerablechangeamong the groups ($P < 0.05$).

Related to the total Mean \pm SD of the overall score of the NEECHAM in the three nights was 20.90 ± 1.82 in the routine care group versus 23.66 ± 1.613 in the experimental group. There was a sharp difference among the trial groups ($P < 0.05$).

Table five show frequency distribution of patients regarding delirium occurrence and its types: Regarding to delirium occurrence in the first post-operative night, all patients in the study groups were confused. While this confusion and delirium dramatically decreased in the second and third night in the experimental group vs. routine care group with an obvious significant change ($P < 0.05$). Regarding to delirium type, results revealed that the majority of patients in the first night in the routine care group were patient with moderate to severe confusion (82.857%). While in the experimental group, (64%) of patients were with mild confusion with considerable significant change ($P < 0.05$).

Figure (2) show the correlation between sleeping quality and delirium: Results revealed that there was positive correlation between sleeping quality and delirium occurrence.

V. Discussion

There was dramatic improvement in sleep quality in the experimental group versus the routine care group. These findings could be explained as the melatonin secretion has been elevated in the presence of eye mask that prohibit the light that suppress melatonin secretion. These findings were supported by (Dave et al., 2015), his study concluded that a highly dramatic improvement in quality of sleep among patients with critical illness has been achieved by using the earplugs and eye masks. He divided his study to two groups A and B. In group A, the mean score of subjective sleep was found to be 45.86 ± 4.86 without intervention and 70.26 ± 5.89 with intervention. In group B subjective mean sleep score was found to be 68.74 ± 6.54 with intervention and 43.06 ± 7.31 without intervention among ICU subjects. There was an obvious improvement ($p < 0.01$) in quality of sleep after intervention vs. routine environment (no intervention).

(Daneshmandi, Neiseh, SadeghiShermeh, & Ebadi, 2012) studied the sleep quality in patients with acute coronary syndrome by using eye mask. There was a sharp drop in the total sleep quality score of the case group after intervention (4.86 ± 1.88) from before intervention (10.46 ± 4.09) ($p < 0.000$). In addition, total score of sleep quality after intervention in the case group (4.86 ± 1.88) was dramatic different from the control group (8.43 ± 1.97) ($p < 0.005$).

In this later study, there was strong positive correlation between mean ROCK score and mean NEECHAM score. These findings provided a conclusion that when the ROCK score increased this mean that sleeping quality has been improved which lead to more relaxation and less confusion to the patients. These results were in line with (Lane & East, 2008) who illustrated that, sleeping with earplugs, showed a median NEECHAM score of 26 (5 to 29) vs. 24 (8 to 29) (Mann-Whitney U, $P = 0.04$) sleeping without earplugs. More cognitively, in the group sleeping with earplugs, normal patients were found ($P = 0.006$). The control group scored 20% and the study group scored 19% delirium, the most change was noticed in the mild confusion group. The control patients scored 40% mild confusion, whereas patients sleeping with earplugs showed 15% in this category. Taking categories, delirium and mild confusion, into account, 60% of the control group showed cognitive disturbances against only 35% in the study group.

There was significant decrease in delirium occurrence in experimental than routine care groups. These results were related to the improvement in sleeping quality in the experimental group than routine care group. These results were supported by (Lane & East, 2008) who mentioned that earplugs with or without eye masks, provided information suitable for two different meta-analyses. These meta-analyses showed a fewer prevalence of delirium during ICU stay (risk ratio 0.55, 95% confidence interval (CI) 0.38 to 0.80, P value = 0.002, two studies, 177 participants) and a positive effect of earplugs with or without eye masks on total sleep time (mean difference 2.19 hours, 95% CI 0.41 to 3.96, P value = 0.02, two studies, 116 participants). In addition to (Alway, Halm, Shilhanek, & Pierre, 2013) studied the effect of earplugs and eye mask on sleeping and delirium outcome in critical patients. In his study, the use of earplugs and eye masks decreased the risk of delirium or confusion by 50% (hazard ratio, 0.47; 95% CI, 0.27-0.82).

Moreover, (Patel, Baldwin, Bunting, & Laha, 2014) conducted study about the effect of multicomponent bundle on sleep and delirium. One of the component of the bundle is using eye mask and earplugs. The interventions bundle surged mean (SD) sleep efficiency index ($60.8 (3.5)$ before vs. $75.9 (2.2)$ after, $p = 0.031$); dropped mean sound ($68.8 (4.2)$ decibels (dB) before vs. $61.8 (9.1)$ dB after, $p = 0.002$) and light levels ($594 (88.2)$ lux before vs. $301 (53.5)$ lux after, $p = 0.003$); and declined number of awakenings caused by care activities overnight ($11.0 (1.1)$ before vs. $9.0 (1.2)$ after, $p = 0.003$). In addition, the introduction of the care bundle showed a downward trend in the rate of delirium ($55/167 (33\%)$ before vs. $24/171 (14\%)$ after, $p < 0.001$), and less time spent in delirium ($3.4 (1.4)$ days before vs. $1.2 (0.9)$ days after, $p = 0.021$). Upward trend in sleep efficiency index were associated with a lower odds ratio of developing delirium (OR 0.90, 95% CI 0.84–0.97).

This recent study revealed that there was a sharp drop in the length of ICU stay in the experimental group vs. the routine care group (p value = 0.001) and this can be explained as the reduced prevalence of delirium in the experimental group has led to the decrease in the ICU stay. These results were in line with (Daneshmandi et al., 2012) who mentioned that delirium is combined with a surge in morbidity and mortality. Both ICU and overall hospital costs show an upward trend in the presence of delirium. In the light of this, the multicomponent bundle of interventions could also reduce healthcare costs. These results were in contrast with (Lane & East, 2008) who mentioned that Only one study measured length of stay in the ICU and found no significant effect of earplugs plus eye masks.

Study limitations:

Study involved only postoperative cardiac ICU subjects, conducted in single setting with small sample size and objective sleep assessment was not done.

VI. Conclusion:

The findings of this study highlighted that eye mask can dramatically improve the sleep quality of postoperative cardiac patients. Accordingly, critical care nurses can use eye mask to optimize sleeping quality either in combination with current treatments or alternatively without causing them the adverse side effects of routine sleep medications.

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Figures

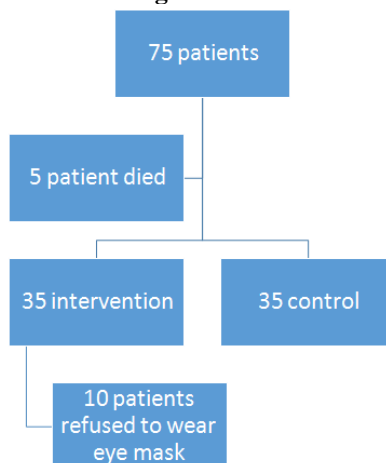
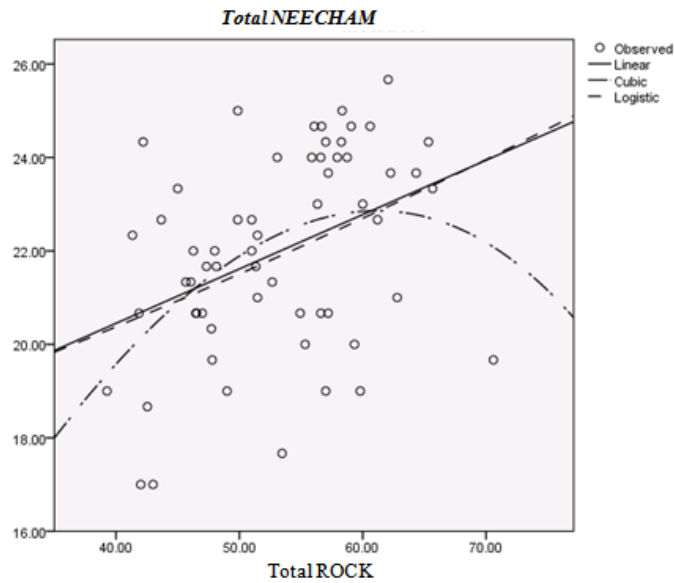


Figure (1) pathway of the study.



ROCK:the Richards-Campbell sleep questionnaire, NEECHAM:Neelon and Champagne Confusion Scale
Figure (2): The correlation between total ROCK and total NEECHAM: ($r=0.153, P \text{ value} = 0.002^*$)

Tables:

Table 1: Socio-demographic characteristics and clinical data in both groups

		Routine care group	experimental group	P-Value
Age		45.828 ± 6.99	46.60 ± 7.615	0.68
Gender: male/female		10/25	19/6	<0.001***
ASA	III	7 (20%)	11 (44%)	0.13
	IV	19 (54.28%)	9 (36%)	
	V	9 (25.71%)	5 (20%)	
Medical diagnosis	CABG	12 (34.28%)	12 (48%)	0.14
	Valve repair	14 (40%)	4 (16%)	
	valve replacement	9 (25.71%)	9 (36%)	
Length of ICU stay (days)		5.000 ± 1.02	4.24 ± 0.52	0.001*

ASA: American Society of Anesthesiology classification
 CABG: Coronary Artery Bypass Graft

Table 2: Intraoperative data in the two groups

Items	Routine care group	experimental group	P-Value
Ischemic time (minutes)	77.31±16.53	77.40 ± 12.77	0.98
Bypass time (minutes)	110.65± 23.36	109.44 ± 20.55	0.84
Duration of operation (minuets)	258.20 ±38.719	256.60 ± 35.78	0.87

Table 3) Comparison of ROCK (Richards-Campbell sleep questionnaire) items between the study groups:

Items	Groups						P value		
	Routine caregroup			experimental group			Pn1	Pn2	Pn3
	N1	N2	N3	N1	N2	N3			
Sleep depth	35.82±7.879	49.885±5.969	60.142±7.456	46.28±6.925	58.28±6.181	66.92±7.454	0.000*	0.000*	0.001*
Sleep latency	35.80±8.039	50.058±6.89	60.00±7.23	45.80±7.75	60.56±5.788	70.32±8.23	0.001*	0.000*	0.000*
number of awakenings	36.74±7.85	50.14±6.25	59.74±6.42	46.60±7.74	60.16±6.20	69.12±7.73	0.000*	0.000*	0.000*
Sleep efficiency	36.94±7.079	50.02±5.40	59.60±7.26	46.92±7.65	60.52±7.10	69.80±8.74	0.001*	0.000*	0.000*
Sleep quality	37.60±7.84	52.14±5.72	61.11±6.79	47.12±7.45	61.48±7.08	71.12±8.73	0.002*	0.000*	0.000*
Total Rock score for each night	36.58±7.41	50.45±5.71	60.12±6.58	46.54±6.97	60.20±6.17	69.45±7.83	0.0000*	0.000*	0.000*
mean Rock score for three nights	49.05 ± 5.65			58.73 ± 5.06			0.000*		

N1: first night, N2: second night, N3: third night.
 Pn1= P value between the study groups in the first night.
 Pn2= P value between the study groups in the second night.
 Pn3= P value between the study groups in the third night.

Table (4): Mean & SD of study groups related to the overall score of the NEECHAM in the three nights of all study groups

days	groups	Mean	SD	P value	95% confidence interval of the difference	
					Lower	Upper
NEECHAM first postoperative morning	Routine care	17.00	2.3	0.001*	-3.69693-	-1.50307-
	experimental	19.60	1.75			
NEECHAM second postoperative morning	Routine care	21.14	2.80	0.001*	-4.95940-	-2.19489-
	experimental	24.72	2.37			
NEECHAM third postoperative morning	Routine care	24.57	1.66	0.002*	-2.41754-	-.59960-
	experimental	26.08	1.82			
Total NEECHAM	Routine care	20.904	1.823	0.001*	-3.47360-	-1.65021-
	experimental	23.466	1.613			

• NEECHAM:Neelon and Champagne Confusion Scale

Table (5) frequency distribution of delirium occurrence in the study groups

	Items	Groups						P value		
		Routine care group (35)			experimental group (25)			Pn1	Pn2	Pn3
		N1	N2	N3	N1	N2	N3			
Delirium	Yes	35 (100%)	29(82.8%)	13(37.14%)	25(100%)	6 (24%)	3 (12%)	-	0.001*	0.03*
	No	0	6(17.14%)	22(62.85%)	0	19(76%)	22(88%)			
Type of delirium	Moderate to severe	29(82.8%)	9(25.71%)	0	9(36%)	1(4%)	0	0.001*	0.001*	0.03*
	Mild	6(17.14%)	21(60%)	13(37.14%)	16(64%)	6(24%)	3(13%)			
	Not confused but high risk	0	5(14.28%)	19(54.28%)	0	14(56%)	11(44%)			
	Normal	0	0	3(8.5%)	0	4	11(44%)			

APPENDIX

<p>Appendix 1: Richards-Campbell sleep questionnaire (RCSQ).</p> <ul style="list-style-type: none"> The original RCSQ tool had five items and evaluated aspects of nighttime sleep including: (1) depth; (2) latency (time to fall asleep); (3) number of awakenings; (4) efficiency (percent of time awake) and (5) quality measured on a 100-mm visual-analog scale (VAS). The five-item RCSQ was used to investigate patients' subjective perception of night sleep. The RCSQ items were constructed as a Visual Analogue Scale (VAS). Each item was marked by individual patients on a 100-mm graduated scale, which went from 0 mm (the worst quality sleep) to 100 mm (optimal sleep). The total score on the RCSQ was calculated by dividing the sum of scores of the items by five. 	<p>Appendix 2: (Neelon and Champagne Confusion Scale (NEECHAM)).</p> <ul style="list-style-type: none"> This tool consists of 9 items divided over 3 subscales. Each item consists of 3 to 6 descriptions. Subscale 1 (information processing) measures attention, processing commands, and orientation; subscale 2 (behavior) measures appearance, motor, and verbal behavior; Subscale 3 (physiological condition) measures vital function, oxygen saturation and urinary continence. The overall score of the NEECHAM ranges from 0 through 30 points. A score of 30 indicates that the patient gives a maximal (normal) reaction and 0 indicates a minimal reaction. The scale gives four grades of outcome: moderate to severe confusion and/or delirium (0–19 points), mild to early confusion and/or delirium (20–24 points), 'not confused' but at high risk of confusion and/or delirium (25–26 points), and normal cognitive functioning i.e. absence of confusion and/or delirium (27–30 points).
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