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The effects of eye masks on post-operative sleep quality and pain in school-age children with CHD

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Abstract

Objective: This study aimed to explore the effects of eye masks on the sleep quality and pain of school-age children with CHD after surgery. *Methods:* Forty school-age children with CHD who underwent open-heart surgery in the Cardiac Surgery Department of a provincial hospital in China from January 2020 to December 2020 were selected. The children were randomly divided into the experimental group (n = 20) and the control group (n = 20). Children in the control group were given routine sleep care, and the children in the experimental group were given a sleep intervention with eye masks for three nights following the removal of tracheal intubation. The Pittsburgh Sleep Quality Index was used to evaluate the sleep quality of the children. The Children's Pain Behaviour Scale was used to evaluate the pain of the children. *Results:* After three nights of receiving the eye masks intervention, the sleep quality scores of the children in the experimental group were significantly lower than those of the control group, the difference was statistically significant ($p < 0.05$) and the sleep quality of the children in the experimental group was higher. The pain scores of the children in the experimental group were significantly lower than those of the children in the control group, the difference was statistically significant ($p < 0.05$), and the children in the experimental group suffered less post-operative pain. *Conclusion:* Eye masks are a simple, safe and economical intervention, that is beneficial for improving the post-operative sleep quality and relieving post-operative pain in school-age children with congenital heart disease.

Sleep is a basic need for the human beings, and high-quality sleep can promote better recovery of patients.[1] Sleep disorders have common undesirable symptoms for patients in the cardiac ICU.[2] The occurrence of sleep disorders is related to factors such as environmental factors, post-operative pain and discomfort. In addition, life-threatening complications occur in patients with heart disease after surgery, which may cause sleep disorders in patients.[3] Sleep disorders can increase the blood pressure and heart rate in patients with heart disease, which can have a negative effect on post-operative recovery. Because cardiac surgery requires patients' sternums to be split or the thorax to be entered from the intercostal space, patients often suffer severe pain after surgery.[4] Studies have shown that when sleep is disturbed, the sensation of pain is intensified, wound healing is delayed and the pathological process that promotes the development of chronic pain can proceed without restriction.[5] Sleep deprivation is also associated with a lower pain threshold and hyperalgesia.[6] The results of previous studies have shown that eye masks may help improve the sleep quality of patients with heart disease.[7–9] In view of the impact of sleep disorders on pain and the effect of eye masks on sleep quality, this study aimed to explore whether the use of eye masks can improve the sleep quality and reduce post-operative pain in school-age children with CHD after surgery and to provide certain guidance for the post-operative rehabilitation of children with CHD.

Information and methods

Normal information

The clinical data of 45 school-age children with CHD who underwent open heart surgery in our hospital from January 2020 to December 2020 were collected, but five of them withdrew from this study. The children were randomly divided into the experimental group (n = 20) and the control group (n = 20) by the random number table method. The inclusion criteria were as follow: children between the ages of 7 and 12; the patient was diagnosed with CHD and received open heart surgery, and stayed in the cardiac ICU for no less than 3 days; post-operative

echocardiography showed satisfactory correction of cardiac malformations and the tracheal intubation was successfully removed; there were no serious complications during the perioperative period; patients with normal mental state, no intellectual disability and children and their parents agreed to participate in the study and signed an informed consent form. The exclusion criteria were as follows: patients combined with severe pulmonary hypertension and other diseases; severe complications occurred during the perioperative period; patients with sleep disorders and insomnia symptoms before enrolment; patients had a history of chronic pain; obstacles in communication and the children and their parents refused to participate in this study. This study was approved by the hospital ethics committee.

Sample size

The sample size was calculated using the results of a local study conducted by Daneshmandi et al.[10] Based on the results of Daneshmandi and his team, the post-intervention means ± standard deviations of daytime dysfunction dimension were 1.63 ± 0.70 and 0.66 ± 0.47, in the control and experimental groups, respectively. Accordingly, with a type I error probability of 0.05 and a power of 0.80, the sample size was determined to be 15 patients for each group. However, for compensating probable attritions and achieving more reliable results, we recruited 20 patients for each group. Patients were recruited to the study by using the convenience sampling method.

Observation index

The Pittsburgh Sleep Quality Index was compiled in 1989 by Dr Buysse, a psychiatrist at the University of Pittsburgh, USA.[11] This scale was suitable for evaluating the sleep quality of patients with sleep disorders and mental disorders, and it was also suitable for evaluating the sleep quality of ordinary people. The Pittsburgh Sleep Quality Index consists of seven components: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medications and daytime dysfunction. The score for each component ranges from 0 to 3, resulting in a total Pittsburgh Sleep Quality Index score of 0–21 points. The higher the score is, the worse the quality of sleep.[12]

The Face, Legs, Activity, Cry, Consolability scale

The behavioural pain assessment scale comprises five items that are suitable for children aged 0–18 years.[13] Each item was scored from 0 to 2 points, and the total score ranged from 0 to 10 points. The clinical staff observed the children for 2 minutes to evaluate their pain levels of the children. Studies have shown that Face, Legs, Activity, Cry, Consolability scores ≤ 3 indicated slight pain or no pain, scores of 4–7 points indicated moderate pain and scores of 8–10 points indicated severe pain. The Face, Legs, Activity, Cry, Consolability scale is often used to measure post-operative pain in children.[14] Compared with other pain assessment tools, the Face, Legs, Activity, Cry, Consolability scale is simple, well-validated and minimally affected by interpersonal variation.

Intervention methods

During the 3-day period following the removal of tracheal intubation, both groups of children were indwelled with urinary catheters to minimise sleep interruption. Before the start of the experiment, the Pittsburgh Sleep Quality Index score and the Face, Legs, Activity, Cry, Consolability score were determined in the two groups. Children in the control group were given routine sleep care, including reducing light and noise and minimising nighttime treatment and operations. On the basis of routine sleep care, the children in the experimental group were given eye masks for the sleep intervention and wearing them for 9 hours (21:00–6:00). During this period, the researchers provided eye masks for the children in the experimental group and told them about the correct usage. Nurses in the cardiac ICU provided assistance to children wearing eye masks. On the fourth morning of the study (i.e. after the third night of the eye masks intervention), the Pittsburgh Sleep Quality Index scores and the Face,Legs, Activity, Cry, Consolability scores of the two groups of children were reassessed.

Data collection

By searching hospital records, the researchers screened 40 eligible children for the study, and the general data included the children's age, gender, weight, diagnosis, operation time and post-operative mechanical ventilation time and so on. Before the start of the experiment and on the fourth morning of the study (i.e. after the third night of the eye masks intervention), the post-operative sleep quality and pain were performed in the two groups by a trained observer who was a nurse in cardiac ICU.

Statistical analysis

SPSS version 22.0 was used for statistical analysis in the study. The qualitative data were compared between groups by the chi-square test. The quantitative data were expressed as the mean ± standard deviation, and the t-test was used to compare the differences in sleep quality and pain scores between groups. $p < 0.05$ was indicated that the difference was significant.

Results

Table 1 lists the general information of all the children, such as age, sex, weight, type of disease, operation time and mechanical ventilation time. There was no significant difference between the two groups of children, which indicated that the two groups of children were homogeneous; thus, the data were comparable between the groups.

As shown in Table 2, before the intervention, there was no statistically significant difference in Pittsburgh Sleep Quality Index scores between the two groups of children ($p > 0.05$). After the intervention, the scores of the seven domains of the Pittsburgh Sleep Quality Index and the total Pittsburgh Sleep Quality Index scores of the children in the experimental group were significantly lower than those before the intervention, and lower than those of children in the control group. The difference was statistically significant ($p < 0.05$). After the intervention, the scores of sleep latency and sleep duration scores of the children in the control group were lower than those before the intervention, and the difference was statistically significant ($p < 0.05$). There were no significant differences in the scores of subjective sleep quality, habitual sleep efficiency, sleep disorders, use of sleeping medications, daytime dysfunction or the total Pittsburgh Sleep Quality Index scores before the intervention ($p > 0.05$).

As shown in Table 3, before the intervention, there was no significant difference in the Face, Legs, Activity, Cry, Consolability scores between the two groups of children ($p > 0.05$). After the intervention, the Face, Legs, Activity, Cry, Consolability scores

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Table 1. Comparison of general data of the two groups of children

Variable	The experimental group (n=20)	The control group (n=20)	P value
Age (years)	9.5±1.4	9.7±1.2	0.686
Gender			0.744
Male	13	12	
Female	7	8	
Weight (kg)	29.7±4.8	30.6±5.9	0.549
Types of diseases			0.445
Ventricular septal defect	12	15	
Atrial septal defect	5	2	
Pulmonary valve stenosis	3	3	
Operation time (h)	3.2±1.0	3.5±1.3	0.349
Mechanical ventilation time (h)	8.4±2.4	7.7±1.9	0.294
NYHA			0.705
I	16	15	
II	4	5	
III	0	0	
IV	0	0	

NAHY: New York Heart Association.

of the children in the experimental group were lower those that before the intervention and lower than those of the children in the control group, and the difference was statistically significant ($p < 0.05$). There was no significant difference in the Face, Legs, Activity, Cry, Consolability scores before and after the intervention in the control group ($p > 0.05$).

Discussion

The incidence of CHD is relatively high in China, and surgery is an effective method to treat CHD.[15] Compared with other diseases, cardiac surgery is particularly traumatic because of its large incisions, long operation time and the need for extracorporeal circulation.[16] Children with CHD often need a longer recovery period after surgery. Sufficient sleep is essential for recovery after cardiac surgery. When sleep is disrupted or restricted, the body's perception of pain is heightened, tissue repair is delayed and the pathological process that promotes the development of chronic pain can proceed without restriction.[17] Because the cardiac ICU is a busy and often noisy environment, these disturbances can seriously affect a patient's sleep quality.[18] Therefore, reducing the factors that interfere with sleep should be a top priority for cardiac ICU staff. The purpose of this study was to determine whether the use of eye masks affected the sleep quality and pain intensity of school-age children with CHD after surgery. The research results support the two hypotheses and show that the use of eye masks is more effective than conventional care.

Some earlier studies found that the use of eye masks was shown to be significantly more effective than conventional care in improving the sleep quality of patients with heart disease who were admitted to the cardiac ICU.[19,20] The mechanism through which eye masks enhance sleep quality has not been fully elucidated, and the upregulation of melatonin activity may play a major role. Melatonin plays a key role in inducing sleep. As night falls, the secretion of melatonin increases.[21] In the cardiac ICU environment, artificial light at night may affect the body's natural production of melatonin, which may disrupt the sleep of these patients.[22] A study of 19 healthy children showed that the use of eye masks can block out light and eliminate distractions, which was conducive to creating a dark environment suitable for sleep. The dark environment could increase the secretion of melatonin and induce sleep, so it achieved the purpose of improving sleep quality.[23]

Table 3. Comparison of the FLACC scores between the two groups of children before and after the intervention

Item	The experimental group	The control group	P value
Before the intervention	6.0±0.9	5.7±1.4	0.449
After the intervention	4.9±1.1*	5.6±1.0	0.036

* means $p < 0.05$ compared with before the intervention

Table 2. Comparison of sleep quality scores between the two groups of children before and after the intervention

	The experimental group		The control group	
Item	before	after	before	after
Subjective sleep quality	2.03±0.40	1.37±0.32*#	1.96±0.45	1.88±0.34
Sleep latency	1.92±0.42	1.22±0.33*#	1.87±0.38	1.57±0.39*
Sleep duration	1.83±0.51	1.29±0.32*#	1.86±0.44	1.59±0.31*
Habitual sleep efficiency	1.93±0.45	1.34±0.25*#	1.85±0.34	1.80±0.28
Sleep disturbances	1.81±0.45	1.31±0.24*#	1.77±0.36	1.72±0.27
Use of sleeping medications	1.71±0.33	1.26±0.19*#	1.82±0.38	1.83±0.34
Daytime dysfunction	1.81±0.30	1.39±0.35*#	1.83±0.44	1.80±0.47
Total score	13.09±0.98	9.10±0.79*#	12.99±0.99	12.20±0.82

before: before the intervention; after: after the intervention
*: $p < 0.05$ compared with before the intervention
#: $p < 0.05$ compared with the control group

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In addition to improving the quality of sleep, our research results also suggest that the use of eye masks may significantly reduce the severity of postoperative pain. The relief of pain is both immediate (i.e. obvious on the first day after surgery) and continuous (i.e. sustained on the second and third days after surgery). These results indicate that the use of eye masks may be a safe and effective adjuvant to reduce post-operative pain in school-age children after undergoing cardiac surgery. An experimental study in healthy adult volunteers showed that relative to baseline levels, total sleep deprivation significantly decreased mechanical pain thresholds and both REM sleep and slow wave sleep interruptions tended to decrease mechanical pain thresholds.[24] Similarly, Krause's research showed that sleep loss increased the experience of pain. This research further showed that sleep deprivation expanded the temperature range for classifying a stimulus as painful, specifically through a lowering of pain thresholds.[25] In this study, after the intervention, the Face, Legs, Activity, Cry, Consolability scores of the children in the experimental group were significantly lower than those before the intervention, and lower than those of the children in the control group, and the difference was statistically significant ($p < 0.05$). Eye masks interventions can effectively alleviate the post-operative pain of children; thus, it is beneficial to their recovery.

There are some shortcomings in this study. First of all, this is a retrospective study, not a randomised controlled study. Therefore, the cases have certain deviations, but the results still have certain clinical significance. Secondly, this is a single-centre study with a relatively small sample size. Although effective and reliable methods were used to assess sleep quality, the Pittsburgh Sleep Quality Index may be susceptible to recall and expectation bias. More objective sleep monitoring methods, such as polysomnography, may yield more accurate results. Finally, this study was limited to school-age patients with CHD who underwent open heart surgery, and other patients may have different results. Therefore, a multicentre, prospective, randomised and long-term study should be conducted in the future to determine the results of the study.

Conclusion

Eye masks are a simple, safe and economical intervention measure that is beneficial for improving postoperative sleep quality and reducing postoperative pain in school-age children with CHD. It is worthy of promotion and application in clinical practice.

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Competing interests. The authors declare that they have no competing interests.

Ethical standards. This study was approved by the ethics committee of hospital and strictly adhered to the tenets of the Declaration of Helsinki. In addition, all patients' parents signed an informed consent form before the study.

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