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Pediatric perioperative measures of sleep, pain, anxiety and anesthesia emergence: A healing touch proof of concept randomized clinical trial

Laura E. James[a,*], Michele M. Gottschlich[a], Judith K. Nelson[a], Lois C. Cone[b], John E. McCall[c]

[a] Department of Research, Shriners Hospitals for Children® – Cincinnati, Cincinnati, OH, 45229, United States
[b] Department of Imaging Services, Shriners Hospitals for Children® – Cincinnati, Cincinnati, OH, 45229, United States
[c] Department of Anesthesia, Shriners Hospitals for Children® – Cincinnati, Cincinnati, OH, 45229, United States

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ABSTRACT

Background and purpose: The purpose of this study was to determine the impact of healing touch (HT) on sleep, anxiety, anesthesia emergence and pain.

Methods: HT, sham HT, control with an aide (CP) and control groups without the presence of an aide (CNP), underwent polysomnography (PSG) preoperatively. The Yale Preoperative Anxiety Scale (YPAS) score was obtained preoperatively before medications were given and in the preoperative surgery area. Sedation score, anesthesia emergence score and vital signs were recorded. Pain scores were determined by the Observation Pain Assessment Scale (OPAS) postoperatively and at time of discharge. Preoperative laboratory blood was drawn for C-reactive protein (CRP), glucose, cortisol and vitamin D25 levels as indicators of stress and anxiety, and a HT satisfaction survey was given.

Results: Thirty-nine patients consented to participate and were randomly assigned to HT (9), HT sham (12), CP (7) and CNP (11) groups. Mean patient age was 13.0 years, and no significant group differences were found for age, sex, race or patient procedure, categorized as laser, burn reconstruction and plastic surgery reconstruction. Additionally, no significant group differences were detected for any of the PSG parameters, YPAS scores, OPAS scores, medications, anesthesia emergence score, bloodwork or satisfaction survey score. CRP, glucose and cortisol levels were higher in the CNP group, suggesting that pediatric patients undergoing elective surgeries may benefit from more pre-operative support, possibly by HT.

Conclusions: Although no tracked parameters showed statistically significant findings, anecdotal HT benefits included enhanced relaxation and sounder sleep.

1. Introduction

While the incidence of insomnia in the general population is 10–20%,[1] sleep deprivation is present in most critically ill patients [2] and exists in 20–40% of children multiple years following burn injury.[3–6] The chronic nature of post-burn and/or post-surgical dyssomnia is problematic due to its effects on quality of life, wound healing and health. Insufficient restorative sleep stresses patients and may be an impediment to recovery.[5–7]

Energy medicine is recognized by the National Center for Complementary and Integrative Health within the National Institutes of Health.[8] It is based on the concept that there is a universal human energy subject to imbalances and that a therapist can re-pattern the disrupted field by imparting compassionate healing energy into a person to improve health. Healing Touch focuses on reduction of anxiety and improvement in mood,[9] relief of pain,[10] faster wound healing [11] and improvement of sleep.[4] Much of the research demonstrating benefit has employed observational approaches rather than experimental design.

One randomized trial demonstrated that burn patients receiving HT compared to sham treatment had reduced pain scores after 5 days of treatment.[10] Another study [4] found that preoperative, reconstructive pediatric patients 7 years post-burn randomized to HT versus no HT treatment had significantly enhanced total sleep time (TST), % sleep efficiency, stage 2 sleep (N2) and number of rapid eye movement (REM). Findings of a HT benefit provided the impetus for this study.

Because clinical and pharmacological modulation of post-burn sleep disturbance has been largely ineffective,[12–14] this study explored the utility of HT as a potential therapeutic intervention to improve sleep in hospitalized children during the perioperative period, as well as to

* Corresponding author.
E-mail address: lejames@shrinenet.org (L.E. James).

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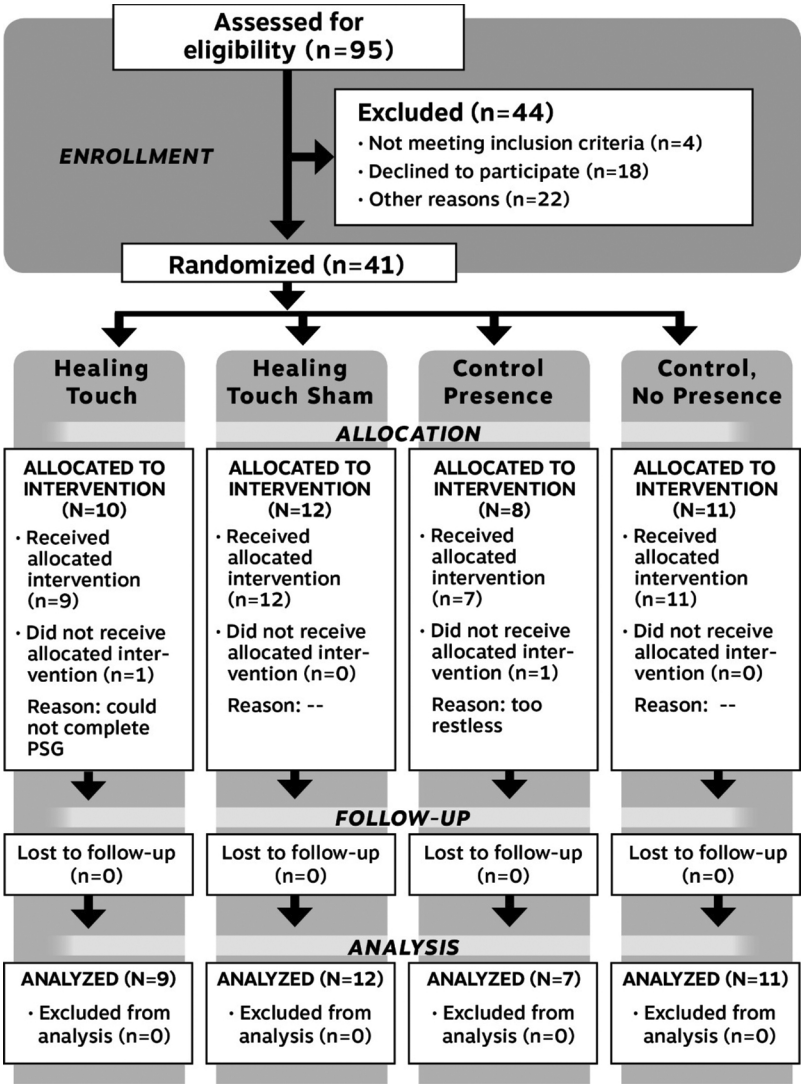

Fig. 1. Study Diagram.

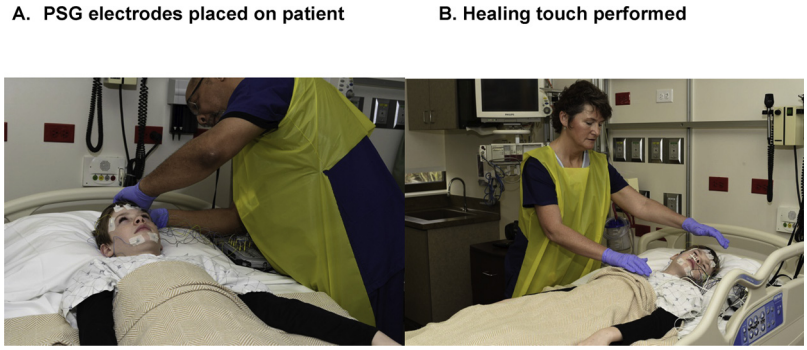

Fig. 2. A. PSG electrodes placed on patient B. Healing touch performed.

characterize electroencephalographic energetics associated with HT.

2. Methods

2.1. Study design and participants

The study protocol was approved by the Cincinnati Children's Hospital Medical Center Institutional Review Board and was registered at ClinicalTrials.gov (NCT 01,870,076). The study was open to patients, 5–21 years of age, scheduled for an elective operation at a pediatric burns hospital. Patients of both sexes and all ethnic backgrounds were consented and provided HIPAA releases signed by the parent or legal guardian. Assent by patients was requested as appropriate. Exclusion criteria included a history of anoxic brain injury or head injury in the past year, face/head issues that prevented the placement of polysomnography (PSG) leads, or the lack of informed consent and HIPAA release. This was a stratified randomized block design, with group assignment accomplished by a randomization table generated by the in-

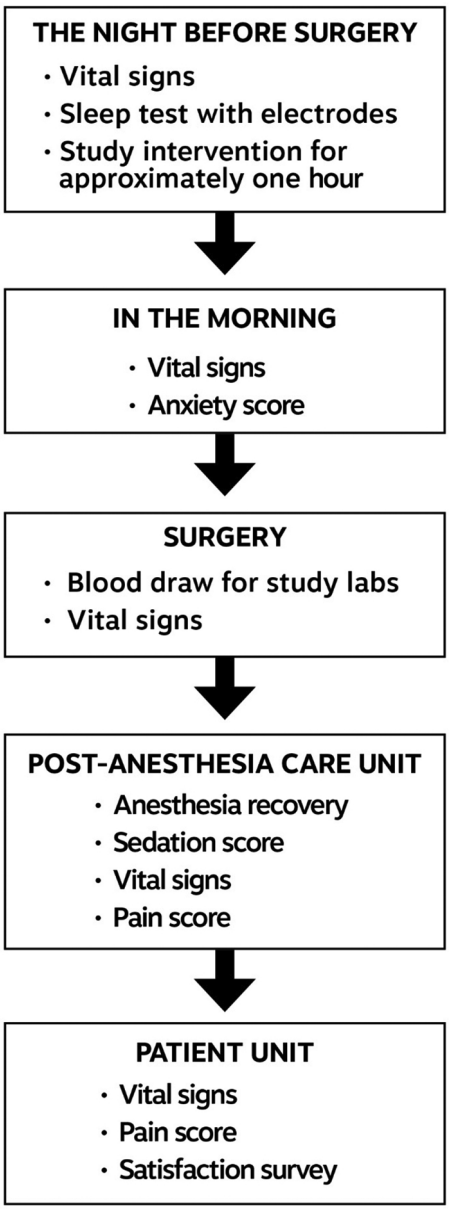

Fig. 3. Flow of patients through the study.

house biostatistician (Fig. 1).

Initially burn and plastic surgery reconstruct patients were stratified into two age groups (5–11 vs. > 11 years of age) and two acuity levels (same-day surgery and observation vs. surgical procedure with admission). Patients then were randomly assigned to HT, HT sham, control/presence (CP) and control/no presence (CNP) groups. All interventions were done the night before a reconstructive surgery procedure, and description of the sequence and duration of the study procedures is summarized in Fig. 2.

Patients were enrolled in the study between December 2015 and May 2017. All study procedures were accomplished the night prior to surgery in a room designated for PSG and completed the day of surgery in the post-anesthesia unit (PACU) of a pediatric burns hospital (Fig. 1).

2.2. Interventions

HT goals [15] were to create an atmosphere free of anxiety so that the mind could be cleared and the full body connected (chakra). The HT practitioner had the appearance of listening to music by using a headset that was not connected to the media player, which provided music to the patient. The patient was encouraged to relax while supine, and the HT practitioner performed self-centering exercises at the bedside both to center the patient and to quiet the HT practitioner's mind so that (s) he could focus with full presence and with compassion. The practitioner used three techniques during the approximately 60 min of soft background music, as healing touch practitioners are trained to use. The first technique was magnetic clearing for about 10 min to clear the patient's energy field and so to release emotional debris and feelings of fear, anger, worry and tension. The HT practitioner did the energy clearing by making 15–30 full-length, smooth, gentle, continuous passes, usually in the downward and outward direction, with both hands one to six inches from the patient's body. Secondly, the practitioner tried to do mind clearing to relax, focus and quiet the patient's mind for another 10 min. The practitioner's hands were placed lightly on or above the specific sites around the head, forehead and face to try to balance both sides of the patient's brain. Finally, for about 20 min the practitioner placed hands on the ankle and knee and the knee and hip of one leg and then on the other leg, then both hips and then at the root chakra between the legs but off the body about 12 in. The practitioner's hands continued to move to the abdomen, the abdomen and solar plexus, the solar plexus and spleen, the heart and solar plexus, the heart and thymus, the wrist and elbow, the elbow and shoulder, the other arm, both shoulders, the neck and brow, the brow and top of the head and the top of the head about 12 in. above the head. Both Healing Touch Certified Practitioners (level 5+) were members of Healing Touch Program (Fig. 2).

The HT sham session had the same soft background music, and the HT aides engaged with the patient. The HT aides had seen HT performed so they could imitate arm movements, but they had no HT experience or knowledge. The encounter with the patient, therefore, was similar to HT treatment and standardized but only mimicked HT, without any positive intent or patient contact. In fact, HT aides listened to iPod music while counting backward from 100 to 1, repeating this sequence, and the intervention lasted one hour.

The CP group had time with a research aide totally unfamiliar with HT. That is, the patients in the CP group simply had an individual with them as they fell asleep. Patients had been told that this aide could not talk with them. The CP aide had no interaction with the patient but sat quietly in a corner, listening to iPod music with headphones while the CP patient listened to the same soft music that the HT and HT sham patients listened to. The headphones for both the HT sham and CP aides were used to keep the aides distracted and disconnected. The CP aides were with the patient for an hour, consistent with the methodology for HT and sham interventions.

The CNP group had no aide with the patients as they fell asleep. A description of the sequence and duration of the study procedures is summarized in Fig. 3.

The rationale for the four-group design was that the HT sham group was a control for the HT group, and the CP group was a control for the HT sham group, while the CNP group was a control for the CP group. Thus, the CNP group was the pure control, with no intervention at all, and the CP group was to determine if someone present in the room would have any impact on sleep and stress/anxiety parameters. The HT sham group was to allow researchers to determine if someone doing a similar process to HT would have the same effect as HT (real intervention) group. The hypotheses were that investigators would be able to tease out impacts of varying levels of support to a child the night before surgery.

2.3. Outcomes

The treatments and sleep evaluation by PSG were performed from 2200 to 0600 with a Sandman Elite instrument (Embla Systems, Thornton, CO) using technique previously described.[14] Sleep stages were determined by standard electroencephalogram, electro-oculogram

and electromyogram criteria. The time from PSG initiation to any sleep stage was characterized as sleep latency. Sleep latency to REM was the amount of time between the start of PSG and the achievement of REM sleep.

The Yale Preoperative Anxiety Scale (YPAS) [16] score was obtained preoperatively before medications were given and in the preoperative surgery area. The YPAS measures activity, vocalization, emotional expression, state of apparent arousal and use of parents, with total scores ranging from 1-21. Vital signs were taken and pain scores were measured by the Observational Pain Assessment Scale (OPAS).[17] The OPAS was assessed postoperatively both upon arrival to the PACU and before PACU discharge. Restlessness, muscle tension, facial expression, vocalization and wound guarding scores comprise the total OPAS score, which ranges from 0 to 10.

Sedation score [18] and anesthesia emergence score,[19] as well as minutes in the operating room (OR), PACU, and patient room, also were recorded. The Richmond agitation-sedation scale (RASS) has a score ranging from -5 (unarousable) to +4 (combative). The anesthesia delirium emergence scale is comprised of five statements about a child's ability to engage with his/her environment and has scores ranging from 0 to 20, with a higher score indicative of poor emergence.

Pre-operative blood was taken in the OR before anesthesia was administered to measure C-reactive protein (CRP), glucose and cortisol levels as indications of stress and anxiety. Vitamin D25 was measured as a determinant of hormonal balance following HT intervention. Reports of the linkage of sleep to CRP [20] and to the metabolism of glucose [21] and of vitamin D exist.[22] Finally, a HT satisfaction survey was given to patients who completed the survey on their own or to parents of children too young to complete the survey.

The study objectives were to determine the effectiveness of HT intervention on sleep parameters, as determined by PSG, with secondary outcomes of determining the value of HT on perioperative management of surgery-related outcomes. Those outcomes measured anxiety, pain and laboratory indices of stress (cortisol, glucose, CRP, vitamin D25), as well as anesthesia emergence, sedation and postoperative nausea and vomiting. Impact of HT on patient satisfaction also was considered.

2.4. Sample size determination

Sample size estimation prior to the study found that 200 patients would be sufficient to detect differences in PSG parameters. However, due to the funding period truncating at 3 years, only 41 patients were enrolled. Sample size estimation was done using the "plan" procedure in SAS® (version 9.4, SAS Institute, Inc., Cary, NC) by an in-house biostatistician (LEJ).

2.5. Statistical analysis

Comparisons among the four preoperative treatment groups were made by analysis of variance, the nonparametric Kruskal-Wallis test and χ^2 tests. Subsequent tests were done by Student's t-tests, and all tests used two-tailed p-values, with statistical significance set at $p < 0.05$. Data were expressed as means and standard deviations or as counts and percentages. All data were analyzed by use of SAS®, version 9.4 (SAS Institute, Inc., Cary, NC).

3. Results

The 41 patients who consented to participate were randomized as follows: 9 to HT, 12 to HT sham, 7 to CP and 11 to CNP. Two patients (1 from the HT group and 1 from the CP group) did not complete overnight PSG, and for bloodwork variables collected the morning of surgery only 37 patients contributed. One patient did not have general anesthesia, and no blood was drawn on the second patient.

Overall mean patient age was 13.0 years, and no significant difference in age group or acuity level was found among the groups. There was no significant difference in age, sex or race among the four groups. Surgical procedures were categorized as laser or as burn or plastic surgery reconstruction, and groups were evenly matched for level of surgical procedure (Table 1).

Table 1
Patient Demographics.

Variable	Healing Touch n = 10	Sham Healing Touch n = 12	Control Presence n = 8	Control no Presence n = 11
Age (years)	13.3 ± 4.1	12.4 ± 4.4	13.5 ± 4.8	13.1 ± 5.9
Sex (F)	6 (60)	7 (58)	6 (75)	4 (36)
Race (Caucasian)	5 (50)	9 (75)	4 (50)	7 (64)
Acuity Level (1 = same-day surgery)	3 (30)	7 (58)	5 (63)	4 (36)

Data are presented as mean ± SD or as count (%).

No significant group differences were detected for any of the PSG parameters (Table 2). It had been hypothesized that HT would increase TST, % sleep efficiency, the number of REM periods and REM time and that it would decrease wake after sleep onset (WASO). Longer periods of TST and higher % sleep efficiency are indications of healthy sleep, whereas WASO increases in abnormal sleep.

Additionally, YPAS scores, RASS scores, OPAS scores, anesthesia emergence score, bloodwork and satisfaction survey score showed no differences among groups. Median OPAS scores were 0 for all four time periods and for all groups. Median YPAS scores were 5 for both times for all four groups, except for the HT group which had a median value of 6 at the first time before medications were given prior to surgery. Median RASS scores were -1 for three groups but 0 for the CP group, and median anesthesia emergence scores were 1 for all four groups.

Eight out of the 9 H T patients who answered the satisfaction survey question about having a memory of HT responded that they remembered the HT. Additionally, 8/9 of the 9/12 sham HT patients who answered the question also responded that they had a memory of HT even though the experience they had prior to sleep was sham HT. More HT patients thought that the noise level (one of the satisfaction survey questions) was *very* low compared to the majority of patients in the other three groups saying that it just was low ($p = 0.0304$), possibly indicating that the HT patients were somewhat less stressed by the hospital noise level. Other satisfaction survey questions revolved around difficulty in falling asleep, times awakened and relaxation, and there were no differences detected.

One patient in the HT sham group did not need anesthesia and another patient never had blood drawn, so only 10 of the 12 H T sham patients had preoperative blood work done. Vitamin D25 levels were comparable among all four groups. CRP, glucose and cortisol levels (Table 3) were higher in the CNP group than the other three groups, although not statistically so. The fact that the CNP group showed higher levels of stress indicators in the blood led to development of a hypothesis that preoperative pediatric patients may need more emotional support the night before surgery.

When no differences among the four treatment groups were shown, the combination of HT, HT sham and CP groups was compared to the CNP group to determine if the presence of *any* supportive person with a patient the night before surgery was beneficial. Those results indicated that the CNP group had higher glucose (103.4 vs. 96.7 mg/dL, $p = .0827$), higher CRP (0.31 vs. 0.27 mg/ml, $p = .5890$) and higher cortisol levels (7.9 vs. 6.9 μg/dL, $p = .4851$). While none of these differences was statistically significant, they are clinically meaningful.

4. Discussion

This study revealed that patients with no support prior to sleep the

Table 2
Polysomnography Results.

Variable	Healing Touch n = 9	Sham Healing Touch n = 12	Control Presence n = 7	Control no Presence n = 11
Total Sleep Time (TST; minutes)	318.3 ± 119.6	368.2 ± 79.0	383.1 ± 69.9	367.2 ± 64.2
Sleep Efficiency (%)	71.7 ± 23.3	81.8 ± 15.9	83.9 ± 14.9	83.6 ± 11.0
Wake after Sleep Onset (WASO; minutes)	54.0 ± 49.4	50.3 ± 45.9	46.4 ± 30.4	56.4 ± 45.4
REM (periods)	2.9 ± 1.3	3.6 ± 1.1	3.5 ± 1.3	3.5 ± 1.4
REM (minutes)	62.0 ± 36.1	78.6 ± 32.3	61.1 ± 34.7	66.4 ± 29.4

Data are presented as mean ± SD.

night before their surgery may have had more stress and anxiety than did patients who had some kind of support for the hour before they fell asleep. One conclusion is that reducing preoperative stress and anxiety may be beneficial to patient outcome, although the opposite also is a possibility. That is, the patients with more stress and/or anxiety the night before their surgical procedures had poorer sleep quality and slept less. HT may be one way to provide support to patients facing surgery. It was shown to be effective in the past.[4]

Previous studies have linked both vitamin D metabolism [22] and cortisol [23] to poor sleep. McCarty et al [22] concluded that inadequate vitamin D may result in disordered sleep, although no vitamin D difference was found in this study. It may be that preoperative patients with higher cortisol levels have poorer sleep, but it is a stretch to believe that patients with higher cortisol levels were *randomly* assigned to the CNP group. A prior sleep study looking at cortisol and sleep in children found that children with higher levels of cortisol showed lower sleep quality, as well as less time asleep.[24]

Links between sleep and CRP also have been examined, but some past studies have shown that sleep deprivation over several days impacts CRP.[25] Higher CRP was associated with higher WASO and lower TST and % sleep efficiency. Again, it is possible that patients already having higher CRP levels had less sleep and less efficient sleep and were awake longer after initially falling asleep. It also may be that the patients with suboptimal sleep increased their CRP levels after just one night of poor sleep. Liu et al. [26] found a relationship between poor sleep quality and CRP, and the implication from this paper is that poor sleep precedes the elevated high sensitivity-CRP.

This study accomplished some of its objectives, but the major limitation was the lack of statistical power due to inadequate sample size. This did not permit the authors to substantiate past findings of the benefit of HT [4] or to refute the impact of HT on sleep. Additionally, it would have been useful to have determined if the presence of someone with a pediatric preoperative patient as (s)he fell asleep was as beneficial as HT is or whether a trained HT practitioner could enhance the effect of *any* supportive person's presence with the child. However, estimated sample sizes based on the means and standard deviations seen in this study's PSG parameters and the preoperative fasting stress indicators ranged from 40 to a prohibitive 375 patients/group. Furthermore, while using larger sample sizes based on the descriptive statistics from this current study would result in statistical significance at a power of 85%, those results would not show a benefit to HT.

The authors determined that the four-group design was overly ambitious and contributed little to the goal of determining the effectiveness of HT on sleep or on preoperative anxiety and stress the morning before surgery. Perhaps a two-group study of HT and non-HT would prove to be more doable. The non-HT group could have a supportive person with the patient, which would enable investigators to determine the impact of HT on preoperative sleep, anxiety and stress.

However, the authors also learned how hard it is to recruit patients for a study such as this. Both patients and their parents were reluctant to agree to participate. Several patients were uncomfortable with the PSG sensors, and one patient dropped out of the study because she was unable to tolerate the leads. Parents thought that some of their children were too young to participate. Consequently, it was thought that patient accrual would not be a problem when, in reality, it was.

Premature end of the study before the estimated sample size occurred due to both expiration of funding and loss of the primary investigator (MMG). Unfortunately, funding to complete a future study probably would be difficult to acquire, and most insurance companies no longer permit patients to be hospitalized the night before surgery. Actigraphy bands for home use might be a possibility, but then there would be no way to determine adequately preoperative support of patients.

The authors therefore have concluded that grant funding for hospital admission the night before minor surgery would help assess whether or not patients who had pre-operative support would have enhanced sleep (more TST, higher sleep efficiency, longer REM, less WASO) and lower levels of stress, as measured by fasting glucose, cortisol and CRP in the blood of patients heading into surgery.

5. Conclusions

In conclusion, CNP patients showed 13.2% higher CRP, 6.9% higher glucose and 13.8% higher cortisol preoperatively than those parameters in the combination of the other three groups of patients. However, the only increase to approach statistical significance was that for glucose ($p = 0.055$). Higher CRP and cortisol are associated with poor sleep quality. Enhanced support of preoperative pediatric patients prior to sleep onset may be helpful.

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Table 3
Blood Work Results.

Variable	Healing Touch n = 9	Sham Healing Touch n = 10	Control Presence n = 7	Control no Presence n = 11
CRP (mg/ml)	0.29 ± 0.18	0.25.2 ± 0.11	0.29 ± 0.19	0.31 ± 0.24
Glucose (mg/dL)	94.9 ± 14.9	98.8 ± 6.1	94.9 ± 14.9	103.4 ± 10.2
Cortisol (μg/dL)	6.73 ± 4.22	7.12 ± 4.30	6.94 ± 3.42	7.9 ± 3.5
Vitamin D25 (ng/ml)	24.18 ± 9.06	24.42 ± 5.37	23.0 ± 7.2	23.7 ± 7.21

Data are presented as mean ± SD.

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Conflicts of interest

None.

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