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Effect of Dexmedetomidine Hydrochloride Nasal Spray on Anxiety and Sleep in Patients Undergoing Gynecological Laparoscopic Surgery

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Background: Postoperative sleep disturbances are common after gynecological laparoscopic surgery, possibly delaying recovery. This study evaluated whether additional postoperative administration of dexmedetomidine hydrochloride nasal spray could improve anxiety, sleep quality, and early recovery in patients who routinely received preoperative dexmedetomidine hydrochloride nasal spray.

Material/Methods: In this prospective, single-blind, randomized, controlled, single-center study, 80 patients undergoing elective gynecological laparoscopic surgery were enrolled from June 2024 to December 2024 and randomized to a control group (n=40) or dexmedetomidine group (n=40). Both groups received 50 μg dexmedetomidine hydrochloride nasal spray 30 minutes before anesthesia. The dexmedetomidine group received an additional 75 μg at 9: 30 PM on the night of surgery. Anxiety was assessed using the Hamilton Anxiety Scale (HAMA). Sleep was evaluated using the Athens Insomnia Scale (AIS) and sleep wristbands.

Results: Baseline characteristics, postoperative pain, and postoperative nausea and vomiting were comparable between groups (all $P>0.05$). Both groups showed significantly decreased HAMA scores after preoperative medication compared with baseline (both $P<0.001$). Compared with controls, the dexmedetomidine group showed no significant difference in total AIS score on the night of surgery ($P=0.771$), but had a higher proportion of patients without subjective sleep deterioration (25.0% vs 5.0%, $P=0.012$), longer total sleep time ($P=0.030$), higher proportion of deep sleep ($P=0.040$), fewer awakenings ($P=0.020$), and shorter postoperative hospital stay ($P<0.001$).

Conclusions: Additional dexmedetomidine hydrochloride nasal spray on the night after surgery improved objective sleep structure and reduced subjective sleep deterioration without increasing adverse reactions.

Keywords: Anxiety • Dexmedetomidine • Gynecology • Laparoscopy • Randomized Controlled Trial • Sleep Disorders

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Introduction

Postoperative sleep disorders (PSD) refer to clinical syndromes in which patients develop disorders in the rhythm of sleep and awakening after surgery, resulting in reduced sleep quality or abnormal behavior during sleep [1]. Surgical inflammatory response, surgical trauma, pain, preoperative anxiety, use of narcotic drugs, and the ward environment can induce and aggravate postoperative sleep disorders in patients [2]. Studies have shown that the quality of postoperative sleep is closely related to the patient's postoperative rehabilitation. Patients with postoperative sleep disorders have a longer postoperative recovery time and an increased hospitalization time [3].

Although gynecological laparoscopic surgery has the advantages of less trauma and faster recovery, factors such as perioperative anxiety, pneumoperitoneum stimulation, general anesthesia, catheterization and drainage, ward noise, and nighttime nursing interventions can collectively lead to sleep structure disorders on the night after surgery. Previous studies have suggested that preoperative anxiety is one of the important predictive factors for postoperative sleep deterioration and delayed recovery in patients undergoing gynecological laparoscopic surgery [2,3]. In addition, gynecological laparoscopic surgery includes various surgical procedures, such as hysterectomy, myomectomy, adnexal surgery, and endometriosis-related surgery. The degree of trauma and perioperative stress of different surgical procedures may also affect sleep outcomes.

Dexmedetomidine hydrochloride is a highly selective α 2-adrenergic receptor agonist, characterized by sedation, anti-anxiety effects, analgesic synergy, and less respiratory depression. Its induced brain electrical activity is similar to that of natural non-rapid eye movement sleep, and is therefore considered to have the potential to improve perioperative sleep [4-7]. In recent years, intranasal administration has received attention due to its simple operation, high bioavailability, and ease of use in hospital settings. Randomized controlled studies have shown that intranasal dexmedetomidine can improve postoperative sleep in older adult patients with chronic insomnia, as well as improve perioperative sleep quality and first night sleep performance in patients under general anesthesia [4-7].

Compared with intravenous administration, nasal spray is more suitable for implementation in the standardized administration setting of a non-intensive care unit. Fan et al reported in 2025 that dexmedetomidine nasal spray given the first night after surgery can improve the objective and subjective sleep indicators of patients undergoing gynecological laparoscopic surgery [8]. However, there is still limited research on the strategy of "preoperative unified nasal spray plus postoperative evening additional administration" under the routine clinical pathway in China, especially the lack of comprehensive evaluation data combining anxiety scales, insomnia scales, and wearable device monitoring.

Therefore, this study intends to observe the effect of additional administration of dexmedetomidine hydrochloride nasal spray on anxiety, sleep quality, and early recovery in patients undergoing elective gynecological laparoscopic surgery on the basis of routine application of dexmedetomidine hydrochloride nasal spray before surgery.

Material and Methods

This was a prospective, single-blind, randomized, controlled, and single-center study. The research protocol was approved by the Ethics Committee of the Third Affiliated Hospital of Nanjing Medical University (Changzhou Second Hospital) (ethics approval No. [2024] KY233-01), and all participants signed a written informed consent form before enrollment.

The research participants were 80 female patients who underwent gynecological laparoscopic surgery at the Third Affiliated Hospital of Nanjing Medical University (Changzhou Second Hospital) from June 2024 to December 2024. The inclusion criteria were as follows: age 19 to 60 years; American Society of Anesthesiologists physical status (ASA) grades I-II; and ability to understand and cooperate with scale assessment and sleep monitoring.

The exclusion criteria were as follows: preoperative resting heart rate under 50 beats per minute; electrocardiogram indicating second or third degree atrioventricular block; use of beta blockers in the past month; uncontrolled hypertension; malignant tumors; neurological disorders, mental disorders, or language or cognitive impairments; previously identified sleep disorders requiring long-term medication treatment; severe nasal diseases, obvious tendency toward nosebleeds, or inability to complete nasal spray administration; inability to cooperate with sleep monitors. To avoid population heterogeneity, this study did not include patients undergoing pregnancy-related surgery or cesarean delivery.

The random number table method was used to allocate 1: 1 between the control group (n=40) and the dexmedetomidine group (n=40). Both groups of patients were given dexmedetomidine hydrochloride nasal spray for 2 presses (total dose 50 μg; Jiangsu Hengrui Pharmaceutical Co, Ltd, Lianyungang, China) in the anesthesia induction room 30 minutes before admission for standardized preoperative sedation and anti-anxiety treatment. At 9: 30 PM on the night after surgery, dexmedetomidine hydrochloride nasal spray was given for 3 presses (total dose 75 μg) in the dexmedetomidine group, and no additional drug intervention was given in the control group on the night

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after surgery. Due to the identical preoperative treatment between the 2 groups, the randomized comparison between the groups mainly reflects the effect of additional medication on sleep outcomes on the night after surgery.

Before surgery, all patients were routinely monitored with electrocardiogram, heart rate, non-invasive blood pressure, pulse oxygen saturation, and bispecific index (BIS) after entering the room.

The patient was placed in a supine position and anesthesia induction was administered intravenously with propofol 1.5 to 2.5 mg/kg, sufentanil 0.5 to 1.0 μg/kg, and rocuronium 0.5 to 1.0 mg/kg. After the BIS dropped to about 40, endotracheal intubation was performed. Anesthesia maintenance involved intravenous infusion of remifentanil 5 to 10 μg/kg/h and propofol 3 to 5 mg/kg/h, with inhalation of 1% sevoflurane. Intraoperative BIS was maintained at 40 to 60. Ephedrine or epinephrine was used to maintain hemodynamic stability as needed.

Thirty minutes before the end of the surgery, intravenous administration of 0.25 mg of palonosetron hydrochloride and 5 mg of dexamethasone was given to prevent nausea and vomiting, and 5 mg of hydrocodone was given for analgesia. After the surgery, bilateral transverse abdominal plane block was performed under ultrasound guidance, using 0.25% ropivacaine in a total of 60 mL (30 mL on 1 side). After the patient was fully awake, they left the postanesthesia care unit (PACU).

The main observation indicators were preoperative anxiety changes and postoperative sleep quality. Anxiety was assessed using the Hamilton Anxiety Scale (HAMA) 30 minutes prior to the patient entering the room and before anesthesia. According to previous studies, HAMA scores 0 to 7 indicate no or extremely mild anxiety, 8 to 14 indicate mild anxiety, 15 to 23 indicate moderate anxiety, and of 24 or higher indicate severe anxiety [9,10].

Subjective sleep was evaluated using the Athens Insomnia Scale. One day before surgery, the sleep for the week before surgery was reviewed. Sleep during the night after surgery was evaluated at 8: 00 AM on the first day after surgery, and sleep at 2 nights after surgery was evaluated at 8: 00 AM on the second day after surgery. Follow-up was conducted by phone at 1 month after surgery. The total score range of Athens Insomnia Scale is 0 to 24 points, with higher scores indicating more severe sleep disorders, and a score of 6 or more points indicating the risk of insomnia [11].

Objective sleep was recorded using a sleep wristband (Huawei Technologies Co, Ltd; Shenzhen, China) on the night of surgery and included total sleep time, proportion of deep sleep, and number of awakenings. Postoperative pain was evaluated using the visual analog scale, with 0 indicating no pain and 10 indicating the most severe pain. Postoperative nausea and vomiting was recorded as whether or not it occurred. Safety indicators included adverse events, such as hypotension and bradycardia, with hypotension defined as systolic blood pressure under 90 mmHg or a decrease of over 20% from baseline, and bradycardia defined as heart rate of 50 or fewer beats/min. PACU stay time and postoperative hospitalization days were also recorded.

To improve the interpretability of the results, this study calculated the proportion of patients whose sleep quality on the night of surgery did not decrease compared with that before surgery, that is, the proportion of patients whose subjective sleep did not deteriorate at the night after surgery compared with the reported sleep the week before surgery.

Statistical analysis was conducted using IBM SPSS Statistics for Windows 22.0 software (IBM Corp, Armonk, NY, USA). The Shapiro-Wilk test was applied to continuous variables to evaluate normality. Data that followed a normal distribution are represented by mean±standard deviation, and the independent samples *t* test was used for intergroup comparison. Non normally distributed data are represented by the median (interquartile range), and the Mann-Whitney U test was used for intergroup comparisons. Categorical variables are represented by the number of examples (%), using the χ^2 test or Fisher exact probability method. Paired tests were used for intragroup comparison before and after the intervention. Two-sided *P* values <0.05 were considered statistically significant.

Results

A total of 80 patients were finally included and randomized, including 40 in the control group and 40 in the dexmedetomidine group. The hospitalization outcomes and 1-month postoperative telephone follow-up data were included in the analysis. The research process is shown in **Figure 1**. Due to the limited sample size, prespecified subgroup analyses by age group or surgical complexity were not performed.

There was no significant difference between the 2 groups in age, body mass index (BMI), ASA classification, hypertension and diabetes, and the distribution of anesthesia start time (all *P*>0.05), suggesting that the baseline after randomization was comparable (**Table 1**).

There was no statistically significant difference in postoperative visual analog scale scores and postoperative nausea and vomiting incidence between the 2 groups (both *P*>0.05). There was no significant difference in PACU residence time.

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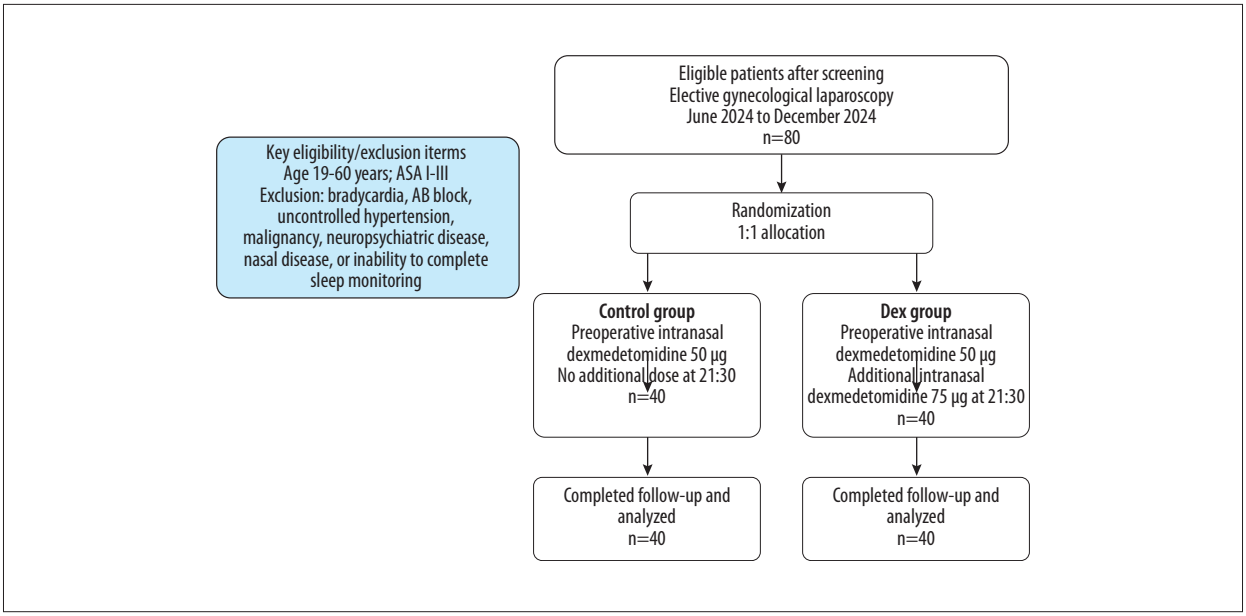

Figure 1. Study flowchart.

Table 1. Comparison of baseline characteristics and anesthesia start time between the 2 groups.

	Control group	DEX group	*P*
Age, median (IQR), y	47 (16)	45 (14)	0.642
BMI	24.3±2.3 (22-26.6)	23.9±1.8 (22.1-25.7)	0.419
ASA I (n,%)	7, 17.5%	5, 12.5%	0.53
Hypertension (n,%)	9, 22.5%	7, 17.5%	0.575
Diabetes (n,%)	5, 12.5%	5, 12.5%	0.632
Which was started at			0.59
08: 00-11: 59 AM	21	21	
12: 00-6: 00 PM	19	19	

Abbreviations: BMI, body mass index; ASA, American Society of Anesthesiologists physical status classification; DEX, dexmedetomidine; IQR, interquartile range. Data are presented as mean±SD (min-max).

The postoperative hospital stay in the dexmedetomidine group was shorter than that in the control group ($P<0.001$). In terms of safety, no significant hypotension, bradycardia, or respiratory depression events requiring clinical intervention were observed in either group (**Tables 2, 3**).

After the patients in both groups received dexmedetomidine hydrochloride nasal spray before surgery, the HAMA score before anesthesia was significantly lower than that before administration ($P<0.001$ in both groups). However, because the preoperative treatment was the same in both groups, the results reflected the changes within the unified preoperative treatment rather than the differences between groups. There was no statistically significant difference in the total Athens Insomnia Scale score between the 2 groups at the time points a week before surgery, the night after surgery, 2 nights after surgery, and 1 month after surgery (all $P>0.05$). However, compared with the control group, the proportion of patients in the dexmedetomidine group who did not experience a decrease in sleep quality on the night of surgery compared with before surgery was higher (25.0% vs 5.0%; $P=0.012$; **Table 3**).

Sleep wristband monitoring showed that compared with the control group, the dexmedetomidine group had a longer total sleep time, a higher proportion of deep sleep, and fewer awakenings on the night of surgery, with statistically significant differences ($P=0.030$, 0.040, and 0.020, respectively). This suggests that adding 75 μg nasal spray of dexmedetomidine on

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Table 2. Comparison of postoperative VAS scores and PONV in the 2 groups.

	Control group	DEX group	*P*
VAS	2.43±0.53	2.32±0.55	0.76
PONV (n,%)	4, 10%	3, 7.5%	0.632

Abbreviations: DEX, dexmedetomidine; VAS, visual analog scale; PONV, postoperative nausea and vomiting.

Table 3. Anxiety score, sleep score, PACU stay time and discharge time of patients in the 2 groups.

		Control group	DEX group	P^b
	PACU stay time, median (IQR), min	26 (8)	26 (8)	0.802
	Discharge time, median (IQR), min	5 (1)	5 (0)	<0.001
Anxiety score	T_1 (30 min before entering the room) median (IQR)	6 (7)	6 (6)	0.684
	T_2 (before anesthesia) median (IQR)	2 (2) P^a	2 (2) P^c	0.395
Sleep scoring	T_0 (1 week before surgery) median (IQR)	0 (2)	1 (2)	0.192
	T_3 (day of surgery) median (IQR)	7 (7)	6 (10)	0.771
	T_4 (first postoperative day) median (IQR)	3 (2)	2 (3)	0.262
	T_5 (1 month after surgery) median (IQR)	1 (2)	0 (2)	0.374
	Sleep quality at T_3 was not reduced compared with T_0 (n=yes,%)	2, 5%	10, 25%	0.012
Complications	T_3 hypotension, slow heart rate (<50 times/min) (n,%)	0	0	0.788

Abbreviations: IQR, interquartile range. PACU, postanesthesia care unit. Note: P^b is the comparison between the 2 groups, and <0.05 is considered to be statistically significant. P^a and P^c are the comparison within the group and 30 minutes before surgery. P^a<0.001, and P^c<0.001 are statistically significant.

Table 4. Objective sleep parameters on the night of surgery.

	Control group	DEX group	t	*P*
Total sleep time, min	474.46±97.77 (376.69-572.23)	562.44±58.79 (503.65-621.23)	2.41	0.03
Proportion of deep sleep,%	22.00±6.66 (15.34-28.66)	28.56±7.18 (21.38-35.74)	2.20	0.04
Number of awakenings	3.15±1.86 (1.29-5.01)	1.33±1.22 (0.11-2.55)	-2.56	0.02

Abbreviation: DEX, dexmedetomidine Data are presented as mean±SD (min-max).

the night after surgery can help improve the objective sleep structure on the first night after surgery (**Table 4**).

Discussion

The present study showed that, when both groups received the same preoperative dexmedetomidine hydrochloride nasal spray regimen, an additional 75-μg dose administered on the night of surgery improved several postoperative sleep-related outcomes in patients undergoing gynecological laparoscopic surgery. Specifically, patients in the dexmedetomidine group had longer total sleep time, a higher proportion of deep sleep, fewer nocturnal awakenings, and a higher proportion of patients without subjective sleep deterioration on the first postoperative night. In addition, postoperative hospital stay was shorter, whereas postoperative pain scores, postoperative nausea and vomiting, and major adverse events were comparable between groups. Notably, although preoperative HAMA scores decreased after the preoperative nasal spray in both groups, the identical preoperative treatment precludes any between-group inference regarding the incremental anxiolytic effect of the postoperative dose.

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Postoperative sleep disturbance is multifactorial and can be influenced by surgical stress, inflammatory responses, pain, perioperative anxiety, environmental disruption, nighttime nursing interventions, and residual anesthetic effects. Patients undergoing gynecological laparoscopic surgery may be particularly vulnerable because perioperative concerns about diagnosis, the procedure itself, postoperative discomfort, and recovery can aggravate anxiety and sleep disruption. In this context, our findings support the concept that perioperative sleep management should begin early and that the first postoperative night may be a clinically important intervention window. This interpretation is in line with the study by Gu et al [3], which showed that preoperative anxiety was associated with poorer postoperative sleep quality and delayed recovery in patients undergoing gynecological laparoscopic surgery.

The observed benefits are also biologically plausible. Dexmedetomidine acts on central α2-adrenergic receptors, particularly within the locus coeruleus, and can induce a sedative state resembling natural non-rapid eye movement sleep, while attenuating sympathetic activation and stress responses. Previous studies have suggested that dexmedetomidine, administered intravenously or intranasally, may improve perioperative sleep quality and continuity. Wu et al [5] reported that intranasal dexmedetomidine improved total sleep time and sleep efficiency in older adult postoperative patients with chronic insomnia, while He et al [6] and Wang et al [7] also described beneficial sleep effects during the perioperative period. Our findings are therefore broadly consistent with the existing literature supporting dexmedetomidine as a sleep-promoting strategy in surgical patients.

Among the currently available studies, the report by Fan et al [8] is the most comparable to ours because it also focused on gynecological laparoscopic surgery and found that dexmedetomidine nasal spray on the first postoperative night improved Athens Insomnia Scale outcomes and wearable device-based sleep parameters. Our results are directionally consistent with those findings. However, the present study differs in design in that both groups received the same preoperative dexmedetomidine nasal spray and were then randomized according to whether an additional dose was given postoperatively. This design more specifically evaluated the incremental benefit of an extra nighttime dose on top of routine preoperative administration and may better reflect real-world perioperative practice at our center. At the same time, because no active comparator, such as a benzodiazepine, was included, our results should not be interpreted as evidence of superiority over other hypnotic strategies, but rather as evidence that adding postoperative dexmedetomidine provided additional sleep-related benefit compared with no further nighttime medication within this treatment pathway.

This study has several limitations. First, this was a single-center study with a relatively small sample size, which limits statistical power and generalizability. Second, although randomization achieved comparable baseline characteristics, prespecified subgroup analyses according to age or surgical complexity were not completed, and residual heterogeneity may therefore remain. Third, the main methodological limitation is that objective sleep was assessed using a wearable sleep wristband rather than polysomnography, the gold standard for sleep-stage analysis; therefore, the precision of sleep architecture assessment, especially sleep staging, was limited. Fourth, complete objective preoperative sleep structure was not recorded, and baseline sleep assessment relied mainly on subjective scoring, which may have reduced the ability to quantify perioperative changes comprehensively. Finally, because both groups received identical preoperative dexmedetomidine, the present study could not determine whether the additional postoperative dose conferred incremental anxiolytic benefit beyond the shared preoperative intervention. Larger multicenter trials with polysomnography-based monitoring and active comparators are needed to confirm these findings.

Conclusions

Additional dexmedetomidine hydrochloride nasal spray on the night after surgery improved objective sleep structure and reduced subjective sleep deterioration without increasing significant adverse reactions.

Declaration of Figures' Authenticity

All figures submitted have been created by the authors who confirm that the images are original with no duplication and have not been previously published in whole or in part.

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