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Original Article

Investigation of the application of Enhanced Recovery After Surgery (ERAS) in elderly patients undergoing surgery for kidney stones

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Abstract: Objective: To investigate the efficacy and application of Enhanced Recovery After Surgery (ERAS) in elderly patients undergoing surgery for kidney stones. Methods: Clinical data of 104 elderly patients who underwent kidney stone surgery at West China Hospital, Sichuan University from January 2020 to December 2022 were retrospectively analyzed in this study. The patients were divided into two groups according to different nursing plans. Among them, 52 patients in the control group received conventional nursing, and 52 patients in the study group received ERAS mode nursing. Postoperative recovery, anxiety, complications, stress response and quality of life were compared between the two groups. Results: The time to recovery of postoperative rehabilitation indices in the research group was significantly shorter compared to the control group ($P < 0.05$). The research group also exhibited a significantly lower incidence of complications such as hematuria, abdominal pain, vomiting, chills, fever, and hypotension (all $P < 0.05$). Before the initiation of nursing care, there were no significant differences in the State Anxiety Inventory (SAI) and Trait Anxiety Inventory (TAI) scores between the two groups (both $P > 0.05$). However, after nursing care, the research group exhibited lower SAI and TAI scores compared to the control group (all $P < 0.05$). Similarly, there was no significant difference in the General Quality of Life Inventory-74 (GQOLI-74) scores in any dimension between the two groups before nursing care ($P > 0.05$), but the research group showcased higher scores in every dimension after nursing care ($P < 0.05$). The levels of Heme Oxygenase-1 (HO-1), Endothelin-1 (ET-1), Adrenocorticotropic Hormone (ACTH), and Cortisol (Cor) were significantly lower in the research group after nursing care (all $P < 0.05$). The acknowledgment and approval scores of nursing care in the research group were higher than those in the control group ($P < 0.05$). Conclusion: The application of ERAS in elderly patients with kidney stones undergoing transurethral ureteral holmium laser lithotripsy is efficacious in mitigating stress reactions, enhancing quality of life and reducing perioperative anxiety, minimizing the incidence of complications, and promoting overall patient recovery.

Keywords: Elderly, Enhanced Recovery After Surgery, nursing, kidney stone, surgery

Introduction

Kidney stones are prevalent in urology, and its incidence has significantly increased in recent years, posing a serious risk to individual health and well-being [1]. Factors such as dietary habits, educational attainment, and environmental conditions may contribute to the development of urolithiasis. Studies have indicated that the incidence of urinary calculi in China is approximately 5% [2, 3]. Numerous studies have established a significant correlation between the manifestation of kidney stones and various chronic ailments, such as chronic kidney disease and diabetes, emphasizing a growing scholarly focus on the prevention and management of nephrolithiasis [4].

In the context of ongoing scientific and technological evolution, minimally invasive methodologies have matured significantly, characterized by precise effectiveness, accelerated recovery, and minimized invasiveness [5]. Specifically, the integration of transurethral ureteroscopic

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holmium laser lithotripsy is gaining public acceptance. This technique utilizes a natural orifice transluminal entry approach, aligning perfectly with the principles of Enhanced Recovery After Surgery (ERAS) [6]. ERAS, rooted in evidence-based medicine, implements a range of standardized interventions to expedite patient recovery and reduce the duration of hospital stay [7]. Currently, many patients undergoing surgical interventions benefit from the ERAS nursing paradigm during the perioperative phase.

The ERAS nursing model includes comprehensive perioperative care, focusing on optimizing preoperative, intraoperative, and postoperative nursing practices to enhance post-surgical recovery and prognosis, thereby achieving the goal of reducing hospital stays and facilitating patient recovery [8]. Day surgery, typically completed within one to two working days, serves as an exemplary application of ERAS [9]. Elderly patients are often accompanied by various underlying diseases, raising clinical concerns about the appropriateness of nursing interventions for this demographic. Consequently, more conservative traditional nursing methods are frequently chosen, though these may not yield optimal rehabilitation outcomes.

In this study, ERAS nursing was carried out in patients undergoing transurethral ureteral flexible holmium laser lithotripsy to assess its influence on the prognosis of elderly patients with kidney stones. Uniquely, this study focused on elderly patients, providing rapid rehabilitation nursing and examining its potential adverse effects on their recovery, a focus that is relatively rare in current research.

Information and methods

General information

A total of 104 elderly patients with kidney stones admitted to West China Hospital, Sichuan University from January 2020 to December 2022 were retrospectively selected and divided into two groups according to different nursing plans, with 52 cases in each group.

The participants in the control group were aged 65-78 years, with a mean age of (69.34±2.34) years, was comprised of 31 males and 21 females. The types of stones were identified, comprising 12 cases with large diameter stones (diameter > 2 cm), 17 cases with staghorn stones, and 23 cases with multiple stones. Concomitant underlying conditions included hypertension in 18 cases, diabetes mellitus in 15 cases, hyperlipidemia in 12 cases, with seven patients presenting with two or more of these conditions. While the participants in the research group were aged between 65 and 76 years, with a mean age of 69.21±3.12 years, consisting of 32 males and 20 females. The types of stones in the research group included 11 cases with large diameter stones (diameter > 2 cm), 19 cases with staghorn stones, and 22 cases with multiple stones. Concurrent underlying conditions included hypertension in 17 cases, diabetes mellitus in 15 cases, hyperlipidemia in 13 cases, with seven patients presenting with two or more of these conditions.

A comparative analysis of the basic demographic and clinical characteristics demonstrated no significant differences between the two groups (all $P > 0.05$). The current project was approved by the Ethics Committee of West China Hospital, Sichuan University.

Inclusion criteria

(1) Patients diagnosed as having kidney stones following clear identification of stones in both kidneys via abdominal CT and ultrasound examination [10]. (2) Patients manifesting with symptoms such as lumbar distension, hematuria, lumbar pain, urinary frequency, and urinary urgency. (3) Patients undergoing holmium laser lithotripsy via transurethral ureteroscopic intervention. (4) Individuals aged between 65 and 80 years, who underwent lithotripsy for the first time.

Exclusion criteria

(1) Individuals with psychiatric or cognitive disorders; (2) Patients with concurrent renal tumors or inflammatory diseases; and (3) Individuals with severe pathologies involving major organs like the liver, brain, or heart.

Methods

Routine care for the control group: Upon admission, dedicated nurses provided detailed explanations about the hospital environment, hospitalization procedures, and surgical procedures

to the patients. Emphasis was laid on preoperative preparations and postoperative safeguards. The nursing staff diligently monitored the progression or changes in the patient's conditions and provided tailored nursing care based on the patient's condition, to mitigate potential complications.

ERAS nursing for the research group: ERAS nursing, which builds upon the routine care provided to the control group, encompasses the following stages:

(1) Preoperative nursing: The assigned nurse actively engaged in conversations with patients and their families. Accompanied by family members, the nurse introduced the ward's ambiance to the patients, familiarized them with the attending medical practitioners, clarified the facilities and the operating room environment, all with the intent of diminishing any unfamiliarity or apprehension. A day prior to the surgical procedure, comprehensive health education was orchestrated, illuminating various aspects of the ailment, therapeutic modalities, and surgical techniques to alleviate any undue anxiety. Considering age-related cognitive factors, it was essential to frequently emphasize key points during medical consultations, especially regarding precautionary measures. Patients experiencing heightened anxiety were subject to targeted interventions. Throughout the counseling procedure, the patient's comprehension and feelings were prioritized. On the eve of surgery, patients were given positional training on optimal surgical postures for surgery, enhancing their collaboration during the surgical intervention. Dietary restrictions, such as a 6-hour pre-surgery fast and necessary intestinal and skin preparations 2 hours before surgery, was mandated to facilitate seamless surgical proceedings. In addition, maintaining a serene ward environment was deemed crucial, with conscious efforts made to minimize disturbances during the nursing routine.

(2) Intraoperative care: During the surgical phase, meticulous attention was focused on the patient's positioning and thermal regulation. Emphasis was placed on monitoring potential pressure points, especially in the abdominal and respiratory regions. The use of soft cushions helped mitigate pressure on the elbows and abdomen. The temperature in the operative suite was rigorously controlled to circumvent hypothermic conditions. Irrigation solutions were kept at a regulated temperature of 28-30°C, mitigating risks associated with temperature fluctuations, such as cardiac arrhythmias.

(3) Postoperative care: a) Positional care: After surgery, patients were required to maintain a decubitus position for the first 6 hours until complete recovery from anesthesia, with their head inclined to one side to reduce malabsorption risks. After this period, depending on individual recovery trajectories, patients were encouraged to do gradual movements, including ankle rotations, positional alterations, and semi-sitting, to promote the recovery of blood circulation and prevent the development of pressure sores. b) Psychological care: Upon awakening from anesthesia, patients were informed of the surgical outcome, and the importance of postoperative measures was emphasized. Patients were also informed that collaborative nursing care could expedite the recovery process. c) Pain management: As the effects of anesthesia gradually diminished, the emergence of pain became conspicuous. Pain levels were continually assessed by the assigned nurse, paving the way for the formulation of personalized pain management strategies. For milder pain, distraction techniques such as meditation, music, or television were advocated. Pronounced pain states warranted pharmaceutical interventions in alignment with medical advisories. d) Nutritional care: Prereturn of bowel function, patients were maintained on intravenous nutrition. A progressive transition from semi-fluid to regular diet was initiated after regaining bowel function. Patients were encouraged to maintain optimal hydration and consume foods high in oxalic acid such as okra and bamboo shoots. Daily intake and output were meticulously documented, ensuring a minimum of 3000 ml of water intake and 2000 ml of urine output daily. e) Complication prevention: Continuous monitoring of vital signs, surgical site inspections for any signs of blood seepage, drainage tube patency, and drainage fluid assessments were conducted to promptly identify and address complications. Patients were advised on limiting lumbar movements to prevent tube displacement and encouraged to maintain excellent personal hygiene to minimize infection risks. f) Discharge guidance: Prior to discharge, patients were provided with

a comprehensive health manual, detailing post-discharge care and were encouraged to adhere strictly to the guidelines. Post-discharge inquiries were facilitated through telephonic consultations. Patients were informed of follow-up schedules and the importance of regular check-ups was reinforced.

Observation indicators

Collection of basic information: Demographic and medical information, including age, gender, presence of diabetes, blood pressure, lipid profiles, height, and weight, was meticulously recorded for each participant.

Perioperative recovery indices: Evaluation of perioperative recovery encompassed the documentation of diverse parameters including duration of catheter retention, operation time, time to postoperative anal exhaust, intraoperative blood loss, bowel sound recovery time, and time to first postoperative feeding.

Compilations: Various complications such as hematuria, abdominal pain, vomiting, chills, fever, and hypotension were carefully recorded.

Assessment of perioperative anxiety [11]: The State-Trait Anxiety Questionnaire was employed to evaluate the levels of anxiety during the perioperative period. This tool includes the State Anxiety Inventory (SAI) and the Trait Anxiety Inventory (TAI), each consisting of 20 items, scored from 0-3. A cumulative score of 16 or below was considered normal. Due to patient age, the questionnaire was administered in an interview format, with nursing staff posing the questions and documenting patient responses.

Comprehensive quality of life assessment (GQOLI-74) [12]: The enhancement of life quality was assessed using the GQOLI-74 scale, examining four dimensions - social function, psychological function, material life status, and physical function. The total attainable score is 100, with higher scores representing superior quality of life.

Blood index examination: Fasting venous blood samples were taken for centrifugation at 3500 rmp for 10 min, and serum was isolated. The serum samples were detected by enzyme-linked immunosorbent assay to determine the levels of adrenocorticotropic hormone (ACTH) (Manufacturer: Wuhan Huamei Biological Engineering Co., Ltd., batch number: 20201006), endothelin-1 (ET-1, manufacturer: Shanghai Zhaowei Bioengineering Co., Ltd., lot number: 20200516), cortisol (Cor, manufacturer: Xinda Biopharmaceutical Co., Ltd., lot number: 20200219) and heme oxygenase-1 (HO-1, manufacturer: Jilin Xinda Biological Engineering Co., Ltd., Lot number: 20200324).

Nursing approval assessment [13]: Upon their return to the hospital for follow-up, patients underwent a nursing intervention approval assessment using the hospital's established scale. This assessment involves four dimensions: nursing attitude, quality of nursing care, extent of assistance to patients, and practicality of nursing care, with a total score of 100. Scores below 70 denoted non-approval, 70-90 signified general approval, and scores above 90 reflected high approval.

Statistical methods

SPSS 22.0 was used for data analysis. Continuous variables exhibiting normal distribution were depicted as mean ± standard deviation (SD) and compared using t-test, while categorical data were represented as percentages and compared using χ^2 test. GraphPad Prism 8 was employed for graphical representations of the study data. $P < 0.05$ indicated statistical significance.

Results

Comparison of baseline data between the two groups

The comparison of baseline data such as gender, body mass index (BMI), age, blood pressure, stone type, and underlying disease between the control group and the research group demonstrated no significant difference (all $P > 0.05$), as shown in **Table 1**.

Comparison of perioperative recovery index between the two groups

The research group exhibited shorter operation time, bowel sound recovery time, postoperative anal exhaust time, intraoperative bleeding, catheter retention time, and postoperative first feeding time in comparison to the control group (all $P < 0.05$), illustrated in **Figure 1**.

Table 1. Comparison of basic data between the two groups (mean ± SD)/[n (%)]

Item		Control group (n=52)	Research group (n=52)	t/χ^2	*P*
Gender	Male	31 (59.62)	32 (61.54)	0.040	0.841
	Female	21 (40.38)	20 (38.46)		
Age (years)		69.34±2.34	69.21±3.12	0.240	0.811
BMI (kg/m^2)		23.58±3.44	23.44±4.39	0.181	0.857
SBP (mmHg)		125.55±10.36	128.14±9.32	1.340	0.183
DBP (mmHg)		73.02±6.95	72.96±7.54	0.042	0.966
Stone type	Extra Large Diameter	12 (23.08)	11 (21.15)	0.177	0.915
	Staghorn Calculus	17 (32.69)	19 (36.54)		
	Multiple	23 (44.23)	22 (42.31)		
Underlying Diseases	Hypertension	18 (34.62)	17 (32.69)	0.069	0.995
	Diabetes	15 (28.85)	15 (28.85)		
	Hyperlipidemia	12 (23.08)	13 (25.00)		
	Two or more	7 (13.46)	7 (13.46)		

Note: BMI: body mass index; SBP: systolic blood pressure; DBP: diastolic blood pressure.

Comparison of complications between the two groups

The research group manifested a reduced incidence of complications such as hematuria, abdominal pain, vomiting, chills, fever, and hypotension compared to the control group (all $P < 0.05$), detailed in **Table 2**.

Comparison of SAI and TAI score between the two groups before and after nursing care

No significant differences were identified in the comparison of SAI and TAI scores between the two groups before nursing interventions (all $P > 0.05$). However, after nursing interventions, the research group exhibited lower SAI and TAI scores compared to the control group (all $P < 0.05$), as demonstrated in **Figure 2**.

Comparison of GQOLI-74 score between the two groups before and after nursing care

Prior to nursing care, no significant difference was observed in the GQOLI-74 scores between the two groups ($P > 0.05$). However, after nursing care, the research group presented significantly elevated scores in the dimensions of GQOLI-74 compared to the control group (all $P < 0.05$), depicted in **Figure 3**.

Comparison of stress index between the two groups after nursing care

Following nursing care, the research group exhibited decreased levels of HO-1, ET-1, ACTH, and Cor compared to the control group (all $P < 0.05$), outlined in **Figure 4**.

Comparison of nursing approval between the two groups

The research group showed a higher nursing approval score than the control group ($P < 0.05$), shown in **Table 3**.

Discussion

Kidney stones typically arise from an elevation in the concentration or a reduction in the solubility of crystalline substances within the urine. Over time, these substances accumulate in the kidneys, forming stones. Due to the considerable size of the stones, alterations in patient position can trigger intense pain and significantly impede the quality of life. Surgery remains a primary approach for treating kidney stones. Among various surgical methods, transurethral ureteral holmium laser lithotripsy is extensively applied and generally yields favorable prognoses [14].

Nevertheless, clinical applications have unveiled that perioperative emotions and compliance levels in certain patients can adversely affect postoperative recovery, potentially giving rise to various complications and impacting patients' treatment experiences and prognoses [15]. Consequently, comprehensive nursing interventions play a crucial role in the care of patients undergoing transurethral ureteral holmium laser lithotripsy, particularly in the cases

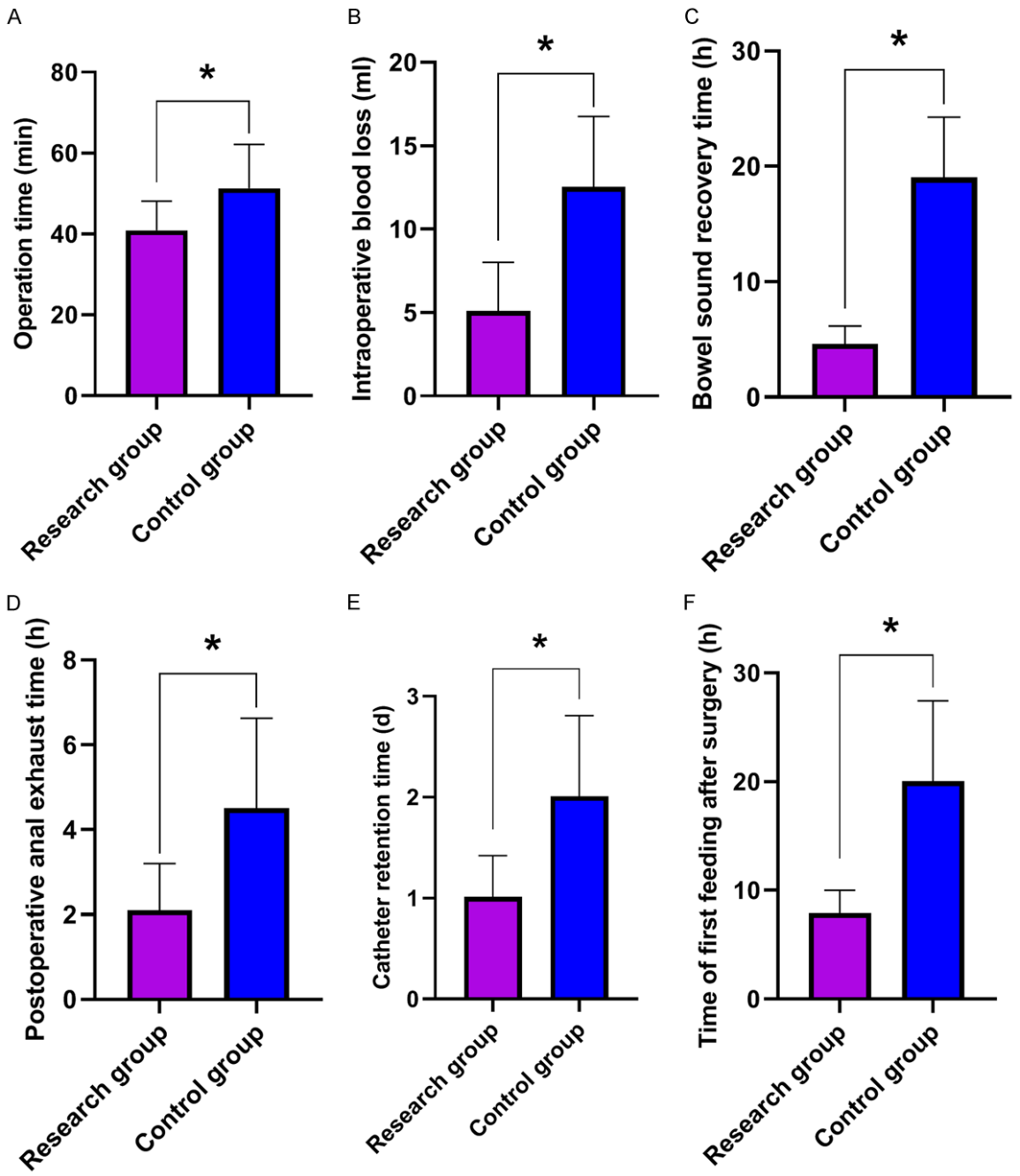

Figure 1. Comparison of perioperative recovery time of each index between the two groups. A: Operation time; B: Intraoperative bleeding; C: Bowel sound recovery time; D: Postoperative anal exhaust time; E: Catheter retention time; F: Postoperative first feeding time. *, $P < 0.05$.

Table 2. Comparison of complications between the two groups [n (%)]

Group	n	Vomiting	Chills	Hematuria	Abdominal pain	Fever	Hypotension	Incidence
Research Group	52	1 (1.93)	2 (3.85)	1 (1.93)	3 (5.77)	1 (1.93)	2 (3.85)	10 (19.23)
Control group	52	0	1 (1.93)	0	1 (1.93)	1 (1.93)	0	3 (5.77)
X^2	/							4.308
P	/							0.038

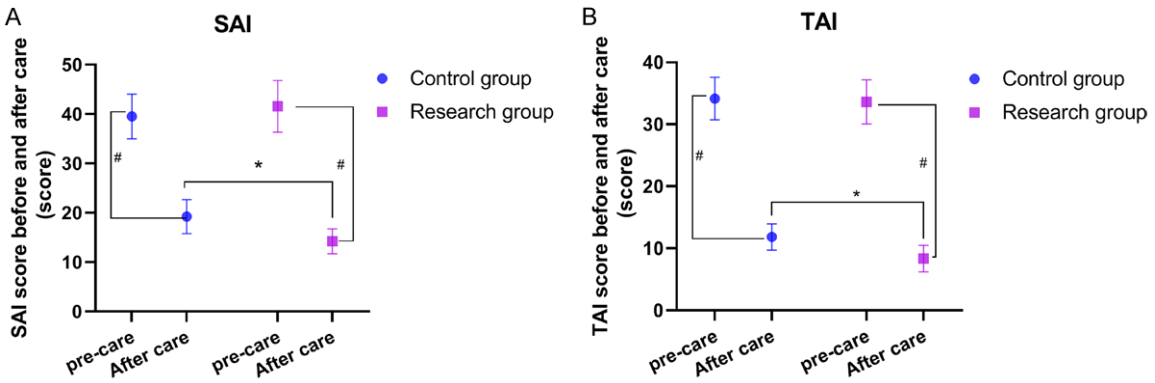

Figure 2. Comparison of patients' SAI and TAI scores between two groups. A: SAI; B: TAI. Note: *, $P < 0.05$, comparison between the two groups. #, $P < 0.05$, comparison between pre- and post-care within groups. SAI: State Anxiety Inventory; TAI: Trait Anxiety Inventory.

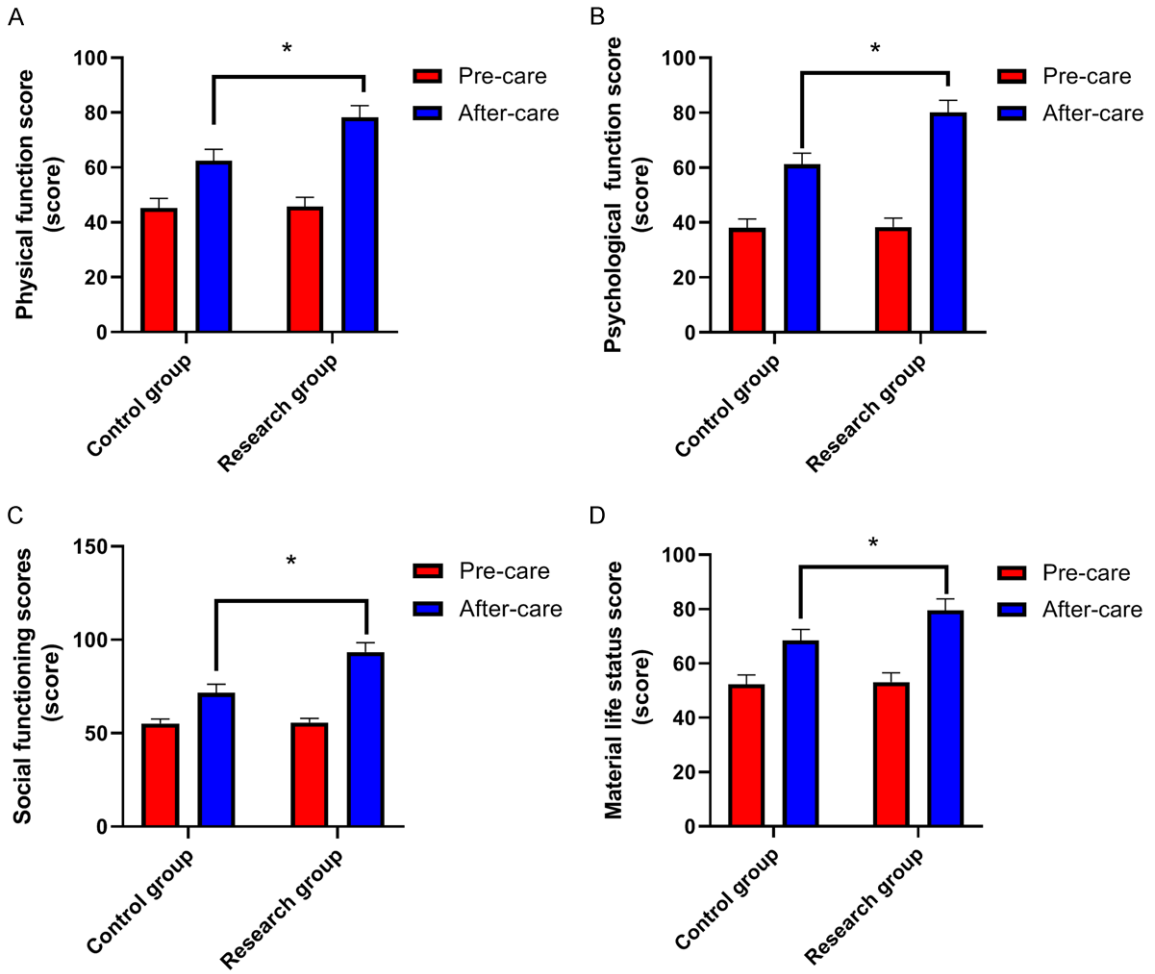

Figure 3. Comparison of GQOLI-74 scores of patients before and after care between the two groups. A: Physical function; B: Psychological function; C: Social function; D: Material life status. *, $P < 0.05$. GQOLI-74: General Quality of Life Inventory-74.

of elderly patients with kidney stones who demonstrate poor treatment compliance [16].

The paradigm of ERAS has been effectively integrated into the diagnosis and treatment of

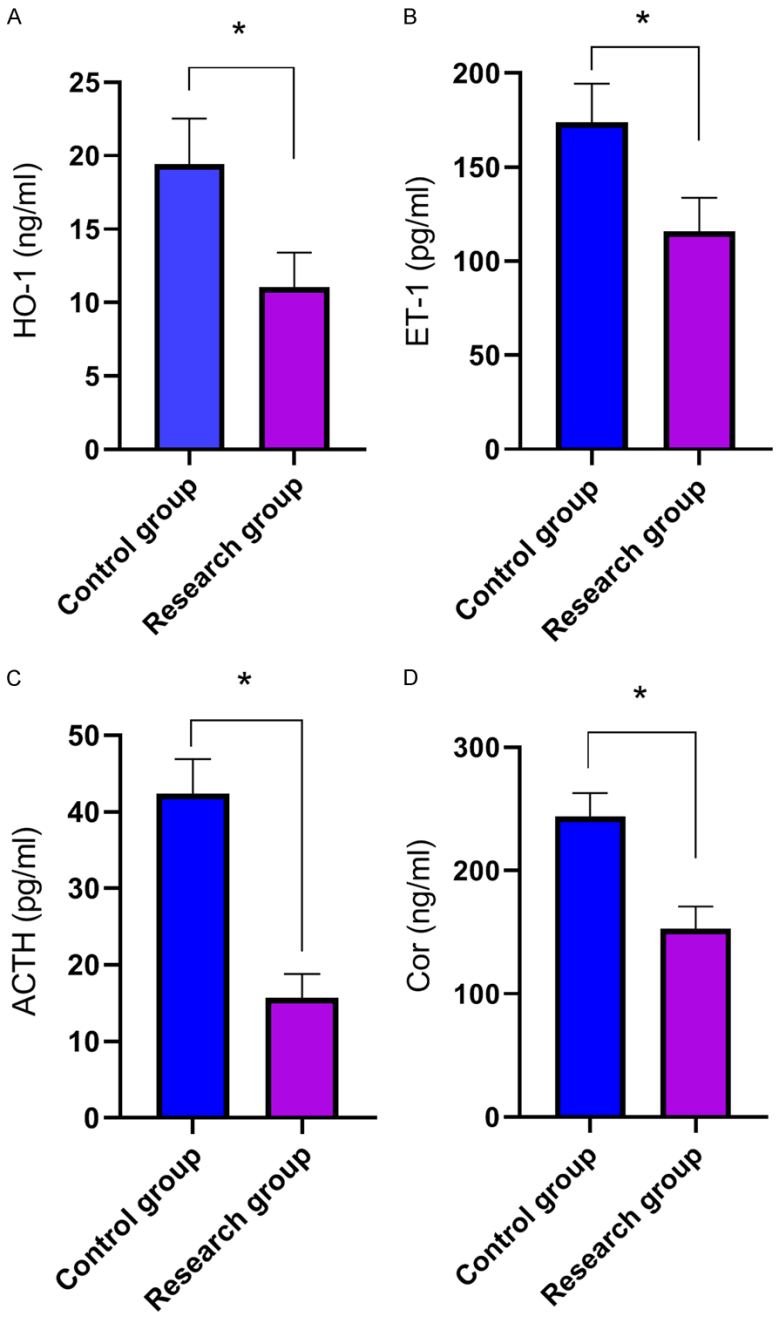

Figure 4. Comparison of HO-1, ET-1, ACTH, and Cor levels between the two groups of patients after nursing care. HO-1: hemoglobin oxygenase-1; ET-1: endothelin-1; ACTH: adrenocorticotropic hormone; Cor: cortisol. *, $P < 0.05$.

Table 3. Comparison nursing care approval scores between the two groups (mean ± SD)

Group	n	Nursing care approval scores
Research Group	52	85.37±3.17
Control group	52	78.44±2.43
χ^2	/	12.511
P	/	< 0.001

numerous diseases. Rooted in evidence-based medicine, it continually refines perioperative nursing interventions with the goal of ameliorating patients' prognoses [17, 18]. This approach emphasizes optimizing patient care, reducing complications, and expediting recovery, thereby enhancing overall treatment outcomes and patient experiences in medical settings. By fostering a supportive and proactive care environment, it mitigates the risks associated with surgical procedures and contributes to the overall well-being and recovery of patients with kidney stones.

Some scholars have confirmed that rapid rehabilitation nursing for elderly patients with kidney stones can effectively promote patient rehabilitation, shorten the hospital stay, reduce the incidence of complications, and save treatment costs [19].

The current study compares the perioperative recovery indices of two patient groups, revealing significant reductions in recovery time and complication rates in patients managed with the ERAS nursing model. This suggests that ERAS nursing interventions can play a pivotal role in expediting patient recovery and mitigating the occurrence of multiple complications, aligning with previous studies.

Suboptimal psychological states have been demonstrated to impact postoperative recovery adversely [20]. This research assessed perioperative anxiety in the two groups and found that, after care, the SAI and TAI scores in

the research group were significantly lower than those in the control group. This suggests that interventions based on the ERAS nursing model can aid patients in maintaining a more balanced psychological state.

Delving into the underlying reasons, it is plausible that patients may experience anxiety due to their lack of familiarity with surgical procedures and the hospital environment. In the intervention group managed with the ERAS nursing model, the designated nurses initially elucidated the disease and treatment plans to the patients, addressing their queries comprehensively and helping them to get familiar with the hospital environment, thereby fostering closer relationships and alleviating anxieties related to unfamiliar medical processes and environments.

The decrease in complication rates is largely attributed to the preventive measures implemented under the ERAS nursing model, which is founded on evidence-based medicine. Consequently, its preventive strategies are more comprehensive and better suited to elderly patients with kidney stones, ensuring a thorough and holistic approach to complication prevention [21, 22].

Surgical stress holds significant implications for patients' postoperative recovery. Various elements such as adverse emotions and treatment compliance are potential mediators of stress in patients [23, 24]. Implementing preoperative psychological interventions and maintaining intraoperative thermal stability can ameliorate postoperative stress responses.

Some scholars have pointed out that good nursing intervention can reduce the degree of surgical stress response of patients, reduce the levels of stress response factors such as HO-1, ET-1, ACTH and Cor, and promote the rehabilitation of patients [25]. In this investigation, we compared postoperative stress markers between the groups and found that levels of HO-1, ET-1, ACTH, and Cor in the research group were markedly lower than those in the control group after nursing intervention, which aligns with the aforementioned findings. This indicates that the psychological interventions and intraoperative thermal conservation measures deployed in the ERAS nursing model can significantly mitigate stress responses, preserving stability in postoperative stress markers and averting stress-induced injuries [26, 27].

In this study, heightened attention was given to post-hospital care, enhancing adherence to medical recommendations during the recovery phase through comprehensive discharge instructions and sustained out-of-hospital monitoring and follow-ups. An evaluation of the quality of life and acknowledgment of nursing interventions for patients in both groups led to the conclusion that the ERAS nursing model elevated postoperative life quality and the recognition of nursing interventions.

However, this study also has some limitations. The small sample size might not fully represent the broader population of kidney stone patients undergoing surgery. In addition, individual variations in patients, such as age, physical condition, and lifestyle habits, could influence the effectiveness of the ERAS approach. Therefore, a multi-center study with large sample size is planned to further verify the findings in this research.

In conclusion, ERAS plays a crucial role in attenuating stress responses, improving quality of life and perioperative anxiety, diminishing complications, and promoting the recovery of elderly patients undergoing holmium laser lithotripsy via transurethral ureteroscopy for kidney stones.

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Disclosure of conflict of interest

None.

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