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Exploration of the Combined Use Strategy of Ketamine Sufentanil for Postoperative Analgesia and Patient Recovery Quality in Laparoscopic Cholecystectomy

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Abstract: The combination of ketamine and sufentanil, two commonly used analgesics in clinical practice, has shown positive effects in pain relief after laparoscopic cholecystectomy surgery. Analyze the effect of this combination therapy mode on postoperative pain relief and patient rehabilitation quality. After comparing and analyzing the medication plans of patients of different age groups, health status, and types of surgeries, it was found that patients who used a combination of ketamine and sufentanil had lower pain scores (VAS) at different postoperative time points compared to those who used the medication alone, reducing the necessity of additional painkillers. Combination therapy promotes the stability of patients' postoperative vital signs and the improvement of their mobility, reducing the incidence of complications.

Keywords: Combination Therapy; Analgesic Effect; Dose Selection; Activity Ability; Complication.

1. Introduction

Minimally invasive laparoscopic cholecystectomy has been widely used in the treatment of gallbladder related diseases, but the postoperative pain experienced by patients remains a major challenge, which affects their quality of life and may increase hospitalization and recovery time. The commonly used ketamine and sufentanil in clinical practice are widely praised for their respective analgesic principles and significant analgesic efficacy. The efficacy and safety of combining these two drugs for postoperative analgesia in laparoscopic cholecystectomy require further research. The aim of this study is to comprehensively analyze the properties and combination therapy of these two drugs, evaluate their effects in reducing postoperative pain and improving patient recovery levels, and provide reference for optimizing the management of postoperative analgesia.

2. Overview of Combination Therapy of Ketamine and Sufentanil

(1) Introduction to ketamine

Esketamine is the right-handed isomer of ketamine, widely used in clinical practice for its unique analgesic and anesthetic properties. Compared to ketamine, it has shown more significant analgesic ability and lower side effects, making it the preferred drug for postoperative pain control. Esketamine can selectively counteract N-methyl-D-aspartate receptors, inhibit glutamate induced nervous system excitation, and exert its analgesic effect. This mechanism of action is particularly effective in treating chronic pain and postoperative pain. Ketamine can also induce an indirect analgesic response by promoting the activation of the norepinephrine neural pathway. Esketamine quickly exerts its effect and its analgesic effect is long-lasting, with efficacy proportional to the dosage administered. The side effects such as nausea, vomiting, and cardiovascular reactions caused by conventional doses are relatively rare. Research has shown that when used in small doses, ketamine can reduce postoperative pain and decrease dependence on other painkillers. More importantly, it helps to reduce the sensitivity of the central nervous system after surgery and lower the probability of chronic pain. In minimally invasive surgeries such as laparoscopic cholecystectomy, ketamine has become a reliable option for postoperative pain relief due to its long-lasting analgesic effect and low side effects.

(2) Characteristics of sufentanil

Sufentanil, as a class of opioid drugs with extremely high analgesic efficacy, is highly praised in the medical field for its excellent analgesic effect and reliable safety. This drug can tightly bind to the μ - opioid receptors in the central nervous system, effectively blocking the pain transmission pathway and exerting strong analgesic functions. Compared to other opioid drugs, sufentanil has stronger receptor binding ability, exhibits rapid action, and its analgesic effect can last longer. The characteristics of this drug are reflected in its lower dosage, mild adverse reactions, and significant analgesic efficacy, which make it uniquely advantageous in postoperative analgesia and anesthesia initiation. Due to its good lipid solubility, sufentanil can quickly pass through the blood-brain barrier, bringing about a more rapid analgesic response. Research has shown that at appropriate dosages, sufentanil can effectively alleviate postoperative pain and reduce the incidence of postoperative complications such as respiratory depression and nausea and vomiting. This drug has a wide therapeutic range, long-lasting effects, and is not easily dependent on drugs, making it particularly suitable for surgeries such as laparoscopic cholecystectomy where postoperative pain is more prominent. When using a combination therapy, combining sufentanil with analgesics such as ketamine can significantly improve analgesic efficacy, reduce adverse reactions that may occur with the use of a single drug, and make postoperative pain management more stable and efficient.

3. Combination Therapy Strategy

(1) Selection of medication dosage for rootcloth patients based on their physical condition

When implementing the combination therapy of ketamine and sufentanil, appropriate dosage adjustment is the core link

to ensure pain relief effectiveness and patient health. The physiological conditions of patients, including body weight, liver and kidney function, heart and lung function, and pain tolerance, will directly affect the metabolic process and analgesic effect of drugs. Adjusting drug dosage based on the specific condition of the patient can enhance the safety of medication and treatment effectiveness. For patients with moderate body weight and no abnormalities in liver and kidney function, a combination of ketamine and sufentanil can be used at regular doses to ensure satisfactory pain relief. For patients who are underweight or have liver or kidney dysfunction, considering the slowing down of drug metabolism and excretion in the body, the dosage should be reduced accordingly to prevent side effects such as excessive sedation or respiratory depression caused by drug accumulation. For patients with poor heart function, special attention should be paid to the possible decrease in blood pressure and heart rate caused by the use of sufentanil, and if necessary, the analgesic goal should be slowly achieved by gradually adjusting the dosage.

(2) Medication methods for different types of surgeries and degrees of trauma

The severity of different surgeries and the resulting trauma play a decisive role in determining the level and duration of postoperative pain. When using the combination therapy of ketamine and sufentanil, the medication use strategy must be adjusted according to the type of surgery and the severity of the trauma to achieve the best pain relief effect. For example, during laparoscopic cholecystectomy, due to the relatively minor surgical trauma, the postoperative pain experienced by patients is usually moderate. It is recommended to use a combination therapy of low-dose ketamine and sufentanil, which can ensure effective pain relief and reduce the risk of side effects caused by drug overdose. For larger incisions such as open cholecystectomy, postoperative pain is intense and lasts for a long time. In this case, it is necessary to increase the dosage of medication, especially sufentanil, in order to quickly alleviate severe pain, and combine it with the use of ketamine to prolong the time of pain relief. The size changes of the trauma encountered during the surgical process are also a key factor in determining the medication plan.

(3) Medication strategies for different age groups

Age is an important factor affecting drug metabolism and analgesic effects. When implementing the combination therapy of ketamine and sufentanil, differentiated medication plans should be developed for patients of different ages to ensure the safety and efficacy of medication. The specific strategies are shown in Figure 1. For the young population, given their strong metabolic capacity and faster drug excretion rate, the combination of ketamine and sufentanil can be used at regular doses to alleviate postoperative pain. Based on the patient's postoperative pain level score, adjust the frequency of drug supply in a timely manner to maintain a stable analgesic effect. For the elderly population, due to the gradual decline in liver and kidney function, the ability to metabolize and excrete drugs is weakened, and special caution is needed in adjusting medication dosage. Reduce the initial dosage appropriately when using ketamine and sufentanil, and control it by administering small doses multiple times to prevent side effects such as respiratory obstruction and blood pressure instability caused by drug overdose. Given that elderly people are more sensitive to medication side effects, their vital signs and potential postoperative complications should be closely monitored. Due to their active metabolism but relatively light weight, pediatric patients should adjust the dosage of medication according to their weight. Considering that children are more sensitive to pain, the proportion of ketamine can be moderately increased to enhance its analgesic effect.

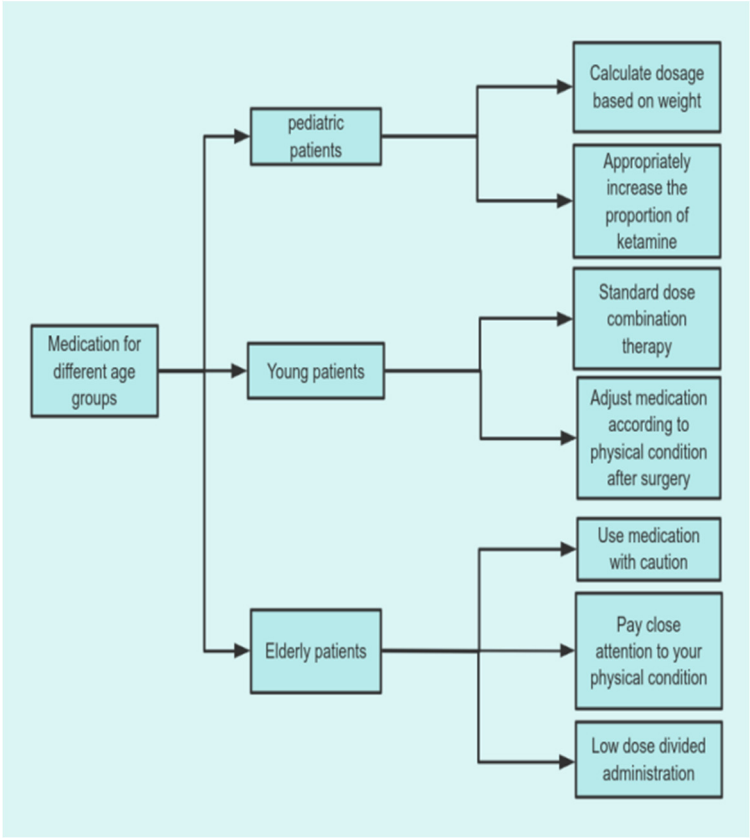

Figure 1. Medication strategies for different age groups

4. Analgesic Effect of Combined Medication after Laparoscopic Cholecystectomy

After performing laparoscopic cholecystectomy surgery, the combination therapy of ketamine and sufentanil has a particularly prominent analgesic effect. By comparing the pain visual analogue scale (VAS) results at 1 hour, 6 hours, 12 hours, and 24 hours after surgery, the study confirmed that this regimen had excellent analgesic efficacy at all time points (see Table 1 for details).

Table 1. Comparison of analgesic effects at different time points

Time point (hour)	Combination therapy group (n=50)	Single medication group (n=50)	P-value
1 hour after surgery	2.1 ± 0.5	3.5 ± 0.8	<0.01
6 hour after surgery	2.5 ± 0.6	4.0 ± 1.0	<0.01
12 hour after surgery	3.0 ± 0.7	4.5 ± 1.2	<0.01
24 hour after surgery	3.2 ± 0.8	4.8 ± 1.3	<0.01

Table 1 data shows that the use of combination therapy strategy can quickly alleviate postoperative pain, prolong the duration of analgesia, alleviate patients' pain perception, and create favorable conditions for postoperative rehabilitation.

5. Recovery Quality of Patients after Combination Therapy

(1) Vital signs

Table 2. Vital signs of patients at different time points after surgery

Time point (hour)	Combination therapy group (n=50)	Single medication group (n=50)	P-value
Postoperative 1-hour heart rate (beats/minute)	78.2 ± 4.5	88.7 ± 6.3	<0.01
1 hour postoperative blood pressure (mmHg)	118/76 ± 8	130/85 ± 10	<0.01
Postoperative 6-hour respiratory rate (times/minute)	16.5 ± 1.2	20.2 ± 2.0	<0.01
Postoperative 24-hour heart rate (beats/minute)	76.3 ± 5.0	85.5 ± 6.0	<0.01

The combined use of sufentanil and ketamine can alleviate patient pain and have a positive impact on maintaining stable life indicators after laparoscopic cholecystectomy surgery. Postoperative pain often triggers the activity of the sympathetic nervous system, leading to unstable changes in heart rate, blood pressure, and respiratory rate. By using this combination therapy, the analgesic effects promote each other, reducing stress reactions caused by pain and keeping the patient's life indicators at a relatively stable level. A comparative analysis was conducted on the life indicators of patients treated with combination therapy and monotherapy at different postoperative time points (see Appendix 2 for details).

Table 2 shows that by comparing the stability of patients' vital signs before and after treatment, the fluctuation of key vital indicators such as heart rate in the combination therapy group was significantly smaller than that in the single therapy group, highlighting the advantages of the combination therapy strategy in maintaining patient vital sign stability.

(2) Recovery of Activity Ability

The recovery of activity ability during the postoperative recovery period is an important criterion for measuring the rehabilitation process, which intuitively reflects the analgesic effect and the overall rehabilitation level of the patient. The combination therapy of ketamine and sufentanil is beneficial for the rapid improvement of postoperative patient mobility due to its excellent analgesic efficacy. This therapy reduces physical discomfort and fear caused by pain, making it easier for patients to engage in bedside activities and get out of bed in a timely manner. According to the research results, patients treated with combination therapy showed significantly faster recovery of postoperative mobility compared to those treated with only a single drug (see Table 3 for details).

Table 3. Postoperative Recovery Effect

Time point (hour)	Combination therapy group (n=50)	Single medication group (n=50)	P-value
Can sit up within 6 hours after surgery	45people（90%）	30people（60%）	<0.01
Get out of bed and walk 24 hours after surgery	42people（84%）	25people（50%）	<0.01
Complete independence within 48 hours after surgery	40people（80%）	20people（40%）	<0.01

According to the data shown in Table 3, the use of a combination therapy regimen promoted the recovery of postoperative motor function in patients and reduced the required rehabilitation time.

(3) Incidence of Complications

Table 4. Comparison of postoperative complications between the combination therapy group and the monotherapy group

Types of complications	Combination therapy group (n=50)	Single medication group (n=50)	P-value
Nausea and vomiting	4people（8%）	9people（18%）	<0.05
Respiratory depression	1people（2%）	5people（10%）	<0.05
Deep vein thrombosis	2people（4%）	6people（12%）	<0.05
Postoperative infection	1people（2%）	4people（8%）	<0.05
Total incidence of complications	8people（16%）	24people（48%）	<0.01

The probability of postoperative complications is a key factor in measuring the safety of medication regimens. Among various complications, postoperative nausea and vomiting, respiratory depression, deep vein thrombosis, and infection are more common, as shown in Table 4.

The use of combination drugs for pain relief not only improves the effectiveness of pain relief, but also reduces the incidence of postoperative complications.

6. Conclusion

The combination of sufentanil and ketamine has shown excellent efficacy in pain relief after laparoscopic cholecystectomy surgery. Research has shown that this approach reduces the pain experienced by patients at different stages after surgery, reduces the necessity of additional use of analgesics, optimizes the effectiveness of analgesic treatment, and enhances patient satisfaction. Combination therapy can help stabilize patients' postoperative life indicators, promote rapid recovery of the digestive system, enhance mobility, and reduce the incidence of postoperative complications. This discovery means that an appropriate combination therapy can ensure good analgesic effects, improve the overall recovery level of patients, and reduce hospitalization time. This study provides a scientific reference for the development of postoperative analgesia plans for laparoscopic cholecystectomy in clinical practice, emphasizing the necessity of adjusting medication strategies based on the specific conditions of patients. Looking ahead to the future, further exploration can be conducted on the application and long-term efficacy of combined medication in different types of surgeries, expanding new possibilities for postoperative pain control.

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