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Continuous Intravenous Ketamine for Management of Acute Pain Postoperative Laparotomy with Septic Shock: A Case Report

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ABSTRACT

Introduction: Ketamine used for patients in the intensive care unit provides a combination of sedation and analgesia as well as a beneficial effect on hemodynamics. This study aims to describe the use of continuous intravenous ketamine as postoperative laparotomy pain management in septic shock. **Case presentation:** A man, 55 years old, came to the emergency room with complaints of abdominal pain accompanied by bloating, nausea, and vomiting. From the anamnesis and physical examination and support, a diagnosis of peritonitis generalisata et causa hernia suspect incarceration was found. In postoperative observation, vital sign examination showed blood pressure 80/50, pulse 128x/minute, respiratory rate 24x/minute, temperature 37.7°C, and numeric rating scale 5/10. The treatment the patient got was simple oxygen mask 6-7 L/ minutes, IVFD ringer lactate 3000 cc/24 hours, intravenous ceftriaxone 1gr/12 hours, intravenous metronidazole 500 mg/8 hours, norepinephrine 0.15-0.2 mcg/kg/minute titration, dobutamine 7.5 mcg/kg/minute titration, fentanyl 0.5 mcg/kg/hour titration, ketamine 0.08-0.1 mg/kg/hour and intravenous paracetamol drips 1gr/ 6 hours. The patient experienced improvement and decreased the need for postoperative fentanyl analgesia from 0.5 mcg to 0.3 mcg/kg/hour. **Conclusion:** The addition of continuous ketamine for acute pain management has been shown to reduce opioid requirements in critically ill patients. The combination of low doses of ketamine together with continuous opioids resulted in a lower pain scale and decreased cumulative use of opioids.

Keywords: acute pain, ketamine, intravenous, postoperative pain, septic shock.

Introduction

Effective postoperative pain management is an essential and humane requirement in any surgical process. Postoperative pain management can free patients from suffering and help patients speed up mobilization, shorten the length of stay, reduce treatment costs, and most importantly, of course, provide patient satisfaction. The main goal of postoperative pain management is to maximize the analgesic effect of drugs with minimal risk of side effects. [1,2]

The use of the anesthetic agent ketamine can be useful in cases of septic shock. [3-5] Ketamine provides a sympathomimetic response that is beneficial in shock patients. Previous studies have shown that ketamine can mimic the response to vasopressor effects in the form of an increase in blood pressure during the initial use of continuous infusion. [6] Therefore, ketamine used for patients in the intensive care unit provides a combination of sedation and analgesia as well as a beneficial effect on hemodynamics. Another study reported lower vasopressor requirements in ventilated patients on continuous ketamine. In addition, even 70.5% of patients showed reduced or no vasopressor requirements after 24 hours of ketamine administration. [7-8] This study aims to describe the use of continuous intravenous ketamine for postoperative laparotomy pain management in septic shock.

Case Presentation

A man, 55 years old, came to the emergency room with complaints of abdominal pain accompanied by bloating, nausea, and vomiting. Initially, there was a lump in the groin of the right thigh that was coming in and out, but since two days ago, it has been unable to come in and out and is getting bigger. From the anamnesis and physical examination and support, a diagnosis of peritonitis generalisata et causa hernia suspect incarceration was found. The patient will be taken for an exploratory laparotomy cito.

On postoperative observation, vital sign examination showed blood pressure 80/50 with norepinephrine support 0.15-0.2 mcg/kg/minute and dobutamine 7.5 mcg/kg/minute; pulse 128x/minute, respiratory rate 24x/minute, temperature 37.7°C numeric rating scale 5/10. The patient was diagnosed with postoperative resection of intestinal anastomosis et causa incarcerata inguinal hernia dextra and septic shock. The treatment that the patient got was simple oxygen mask 6-7 L/minute, IVFD ringer lactate 3000 cc/24 hours, intravenous ceftriaxone 1gr/12 hours, intravenous metronidazole 500 mg/8 hours, norepinephrine 0.15-0.2 mcg/kg/minute titration, dobutamine 7.5 mcg/kg/minute titration, fentanyl 0.3-0.5

mcg/kg/hour titration, ketamine 0.08-0.1 mg/kg/hour and paracetamol drips intravenously 1gr/ 6 hours. Follow-up postoperative observations are presented in Table 1.

Table 1. Follow-up vital signs and postoperative therapy.

Time	Vital sign	Treatment	Laboratory evaluation
1st hour /day 1	**BP: 90/55, HR: 125 x/minute,** RR 24x/minute, **NRS silent 4/10, NRS moving 5/10.**	O_2 6-7 L/minute simple mask, IVFD ringer lactate (RL) 3000 cc/24 hours, Ceftriaxone 1 gr/12 hours, Metronidazole 500 mg/8 hours, omeprazole, 40 mg/24 hours, paracetamol 1gr/6 hours/iv, norepinephrine 0.2 mcg/kg/hour titration, dobutamine 7.5-10 mcg/kg/hour, **fentanyl 0.5 mcg/kg/hour,** ketamine 0.1 mg/kg/hour.	-
3rd hour/day 1	**BP: 92/52, HR: 120 x/minute,** RR 24x/minute, NRS at rest 3/10, NRS moving 4/10.	O_2 6-7 L/minute simple mask, IVFD ringer lactate (RL) 3000 cc/24 hours, Ceftriaxone 1gr/12 hours, Metronidazole 500 mg/8 hours, omeprazole 40 mg/24 hours, paracetamol 1 gr/6 hours/iv, norepinephrine 0.2 mcg/kg/hour titration, dobutamine 7.5 mcg/kg/hour, **fentanyl 0.4 mcg/kg/hour,** ketamine 0.1 mg/kg/hour.	Hb 11.2 gr/dl, WBC 26,000, Platelet 97,500.
9th hour/day 1	**BP: 101/55, HR: 115 x/minute,** RR 22x/minute, NRS at rest 3/10, NRS moving 4/10.	O_2 6-7 L/minute simple mask, IVFD ringer lactate (RL) 3000 cc/24 hours, ceftriaxone 1gr/12 hours, metronidazole 500 mg/8 hours, omeprazole 40 mg/24 hours, paracetamol 1 gr/6 hours/iv, norepinephrine 0.2 mcg/kg/hour titration, dobutamine 7.5 mcg/kg/hour, **fentanyl 0.3 mcg/kg/hour,** ketamine 0.1 mg/kg/hour.	-
15th hour/day 2	**BP: 118/62, HR: 110 x/minute,** RR 20x/minute, NRS at rest 3/10, NRS moving 4/10.	**O_2 2-4 L/minute simple mask,** IVFD RL 3000 cc/24 hours, ceftriaxone 1gr/12 hours, metronidazole 500 mg/8 hours, omeprazole 40 mg/24 hours, paracetamol 1 gr/6 hours/iv, norepinephrine 0.2 mcg/kg/hour titration, dobutamine 5 mcg/kg/hour, fentanyl 0.3 mcg/kg/hour, ketamine 0.1 mg/kg/hour.	-
21st hour/day 2	**BP**: 118/62, HR: 110 x/minute, RR 20x/minute, NRS at rest 3/10, NRS moving 4/10.	O_2 2-4 L/minute simple mask**,** IVFD RL 3000 cc/24 hours, ceftriaxone 1gr/12 hours, metronidazole 500 mg/8 hours, omeprazole 40 mg/24 hours, paracetamol 1 gr/6 hours/iv, **norepinephrine 0.1 mcg/kg/hour titration**, dobutamine 5 mcg/kg/hour, fentanyl 0.3 mcg/kg/hour, ketamine 0.1 mg/kg/hour.	-

Discussion

Sedation and analgesia in the intensive care unit (ICU) for patients with sepsis and poor hemodynamics is a challenge in itself. Opioids and benzodiazepines may contribute to the pathophysiology of shock by impairing tissue perfusion through decreased cardiac contractility, and increased vasodilation, and reduced respiratory rate. Analgesia and sedation are important elements of the intensive care therapy concept.[3]

Ketamine is an N-methyl-D-aspartate (NMDA) receptor antagonist which blocks glutamate and induces analgesia and sedation. Subanesthetic doses of ketamine have been used extensively in the management of pain, both acute, chronic, and palliative. Low intravenous doses of 0.25-0.5 mg/kg as an initial bolus followed by 50-500 mcg/kg/hour have been shown to be an adjunct to postoperative analgesia and to treat opioid-induced hyperalgesia. Previous research related to the addition of ketamine found that the combination of ketamine-opioid significantly reduced the pain scale score, cumulative morphine consumption, and desaturation events in postoperative patients.[9,10]

The use of ketamine in mechanically ventilated patients has shown an increasing trend. Other studies have shown that ketamine can be used as a sedative-sparing agent. The chronotropic effects of ketamine on the cardiovascular system are mediated by the sympathetic nervous system, inhibition of adenosine tri-phosphate sensitive channels, and modulation of vascular tone via endothelial interactions. Increases in systolic and diastolic blood pressure occur within minutes of administration and can increase blood pressure from 10-50% above pre-anesthetic levels. Its characteristics that mimic the response to vasopressor effects confer beneficial hemodynamic effects in addition to analgesia and sedation.[2,9] This was also seen in this case, in which a septic shock patient with the addition of a low dose of 0.1 mg/kgBW/hour ketamine could act as analgesia without worsening the patient's hemodynamics.

In septic shock, ketamine has several advantages because of its beta-mimetic and alpha-mimetic properties.[10,11] The effect is the release of catecholamines from the adrenal glands and cortisone. In cases of septic shock, two-thirds of patients have relative adrenal insufficiency with adequate cortisone levels. This effect results in a reduction in the amount of vasopressor required. Continuous ketamine has been shown to reduce opioid requirements in mechanically ventilated patients. Opioid use was significantly reduced from fentanyl 3 mcg/kg/hour to 1 mcg/kg/hour after 24 hours of continuous ketamine administration. This was also seen in this case, where there was a decrease in the dose of the opioid given.[12]

Due to the lipid solubility of ketamine and its relatively low protein binding (about 20-50%), a sizable volume of distribution (3-5 L/kg) is achieved after intravenous (iv) or intramuscular (IM) bolus doses. In addition, ketamine rapidly crosses the blood-brain barrier, and its concentration in the cerebrospinal fluid maybe four to five times higher than in plasma. Because of these pharmacokinetic features, the analgesic effect of ketamine has a rapid onset. Ketamine is mainly metabolized in the liver, and several metabolites have been identified. This primary metabolite is pharmacologically active, with 30% anesthetic and analgesic potency compared to the main compound.[10,13] Psychotomimetic effects rarely appear at low doses of ketamine 0.125-0.25 mg/kgBB but are more common at higher doses of 0.5-1 mg/kgBB. The maximum dose that may cause side effects such as tachyarrhythmias ranges from 2.08-20 mcg/kg/minute (0.125-1.2 mg/kg/hour).[13,14]

Conclusion

The addition of continuous ketamine for acute pain management has been shown to reduce the need for opioids in critically ill patients. The combination of low doses of ketamine together with continuous opioids resulted in a lower pain scale and decreased cumulative use of opioids.

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