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Esketamine combined with remimazolam in painless gastroscopy in obese patients

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Abstract: Objective To evaluate the effects and safety of esketamine combined with remimazolam in painless gastroscopy in obese patients. **Methods** A total of 138 obese patients who received elective painless gastroscopy at The Fourth Affiliated Hospital of Nanjing Medical University and Nanjing First Hospital from January to December 2022 were selected and randomly divided into group S (esketamine+ramazolam, n=69) and group C (propofol+refentanil, n=69) by random number table method. The incidence of intraoperative hypoxemia, anesthesia induction time, test time, post-anesthesia care unit (PACU) monitoring time, and physician satisfaction were compared between two groups. The mean arterial pressure (MAP) and heart rate (HR) of two groups of patients before anesthesia (T0), at endoscopy insertion (T1), and at endoscopy retraction(T2) were recorded, and the incidence of adverse events were recorded. **Results** The incidence of hypoxemia in group S was significantly lower than that in group C [34.78%(24/69) *vs* 56.52%(39/69), χ^2=6.571，P=0.010]. The induction time for anesthesia in group S was shorter than that in group C [(23.17±2.57) s *vs* (24.71±2.12) s, t=3.840, P<0.01]. Compared with group C, the PACU monitoring time of group S was significantly shorter[(14.74±1.46)s *vs* (17.06±1.87)s, t=8.123, P<0.01], the satisfaction of gastroenterologists [89.86%(62/69) *vs* 75.36% (52/69), χ^2=5.044, P=0.025] and satisfaction of anesthesiologists [92.75%(64/69) *vs* 71.01%(49/69), χ^2=10.991, P=0.001] were significantly higher. At T1, MAP in group C decreased compared to group S, while HR increased compared to Group S (P<0.05). Nausea and vomiting occurred in 9 patients in group C and 5 patients in group S, and no other adverse event occurred. **Conclusion** Compared with propofol combined with remifentanil, remimazolam combined with eszketamine for painless gastroscopy in obese patients can reduce the incidence of hypoxemia and has higher safety.

Keywords: Painless gastroscopy; Obesity; Remimazolam; Esketamine; Propofol; Remifentanil; Mean arterial pressure; Nausea; Vomiting

With increasing health awareness, more and more people are opting for painless gastroscopy when undergoing gastric examinations. Given the growing demand for safe and comfortable gastrointestinal endoscopy, there is a need in clinical practice to explore the optimal sedation strategy for specific high-risk populations, such as obese patients. Currently, there is no consensus on the optimal anesthesia regimen for obese patients undergoing gastrointestinal endoscopy. Propofol combined with short-acting opioids is the preferred anesthesia regimen for gastroscopy because of its reliable sedative and analgesic effects. However, propofol can cause respiratory and circulatory depression [1-2], and injection pain may occur [3]. Additionally, opioids can also cause respiratory depression. Due to reduced functional residual capacity and decreased chest wall compliance, obese patients are prone to hypoxemia during painless gastrointestinal endoscopy [4].

Remimazolam, a new benzodiazepine, produces sedative and amnestic effects by acting on γ-aminobutyric acid (GABA) A receptors in the central nervous system, with rapid onset, rapid metabolism and no effect of infusion time [5-6]. Its sedative effects can be reversed by specific antagonists [7]. Remimazolam has sedative effects similar to those of propofol and is safer in terms of respiratory depression and hypotension [8].

Esketamine is a non-competitive antagonist of the N-methyl-D-aspartatic acid (NMDA) receptor, with an anesthetic effect approximately twice that of propofol, fewer psychotropic side effects, and a higher clearance rate [9]. Its analgesic effect is strong, onset is fast, and it has no significant effect on respiratory function [10]. Nevertheless, there is no clear conclusion on the use of esketamine combined with remimazolam in obese patients undergoing gastroscopy. This study aims to explore the safety of esketamine combined with remimazolam in obese patients undergoing gastroscopy.

1 Data and Methods

1.1 Study design

This study was a single-center, double-blind, prospective, randomized controlled trial. The study was approved by the hospital's ethics committee (approval number: 20230707-k139), and all patients signed an informed consent form. According to the preliminary test results, the sample size was calculated using PASS 11.0 software, with the incidence of hypoxemia as the main research indicator. The incidence is approximately 54% in the study group and 30% in the control group. Assuming bilateral α=0.05, test efficacy 1-β=0.80, a total of 124 patients are required. Considering a dropout rate of 10%, a total of 138 patients were included.

1.2 General Information

A total of 138 patients scheduled for painless gastroscopy at The Fourth Affiliated Hospital of Nanjing Medical University and Nanjing First Hospital from January 2022 to December 2022 were selected. The patients were age 18-65 years, body mass index (BMI) 30-40 kg/m^2, and American Society of Anesthesiologists (ASA) class II. Exclusion criteria: severe snoring and sleep apnea; uncontrolled hypertension; history of drug allergies; long-term opioid use; severe hepatic or renal dysfunction; history of psychiatric disorders; and inability to cooperate. Using a random number table, patients were randomized into two groups: the esketamine + remimazolam group (S group) and the propofol + remifentanil group (C group), with 69 cases in each group. In the C group, there were 40 males and 29 females, with age of (41.57±8.71) years, BMI of (33.67±1.82) kg/m^2, examination time of (8.10±1.66) minutes. In the S group, there were 37 males and 32 females, with age of (40.83±8.72) years, BMI of (33.34±1.51) kg/m^2, and examination time of (7.74±1.39) minutes. There was no statistically significant difference in general characteristics such as gender, age, BMI, and examination time between the two groups (P>0.05).

1.3 Methods

Patients routinely fasted and dehydrated before surgery, and after entering the operating room, a venous access was established, and the patient was placed in the left lateral position with routine electrocardiographic monitoring. All patients received nasal cannula oxygen therapy, with an initial oxygen flow rate of 2-4 L/min. After 1-2 min of oxygenation, medication was administered based on the patient's corrected weight (ideal weight + 0.4 × [total weight - ideal weight]). In the C group, propofol 1.5 mg/kg (10 mg/mL) and remifentanil 1 μg/kg (4 μg/mL) were used for anesthesia induction; in the S group, remimazolam 0.1 mg/kg (1 mg/mL) and esketamine 0.5 mg/kg (5 mg/mL) were used for anesthesia induction. Propofol and remimazolam were slowly injected at a rate of 0.5 mL/s until the disappearance of eyelash reflex. Gastroscopy began after the disappearance of eyelid reflex. During gastroscopy, if the patient exhibited swallowing reflex or a modified observer's assessment of alertness/sedation (MOAA/s) score > 2, an additional dose of propofol 1 mg/kg or remimazolam 0.05 mg/kg was administered, and this process was repeated as needed. Sedation failure was defined as inadequate sedation after the initial dose, requiring four additional doses of propofol/remimazolam within 15 minutes. Corresponding measures were taken based on pulse oxygen saturation (SpO_2) values and duration [11], when SpO_2 < 90%, oxygen flow rate was immediately increased to 6 L/min; when SpO_2 was less than 90% and duration exceeded 15 s, chin lift and chest compression were immediately performed to assist breathing; when SpO_2 < 90% and duration exceeded 30 s or SpO_2 < 85%, oxygen was administered by face mask until SpO_2 returned to pretest levels. Emergency endotracheal intubation was performed if hypoxemia failed to improve. All drugs were stopped at the end of the procedure. Postoperatively, patients were transferred to the post-anesthesia care unit (PACU), and patients were allowed to leave the PACU when their Aldrete score was ≥ 9 or equal to the preoperative level. All gastroscopies and anesthesia were performed by the same gastroenterologist and anesthesiologist.

1.4 Observation indicators

The incidence of intraoperative hypoxemia (SpO_2 ≤ 90%) in both groups was recorded. The induction time of anesthesia (time from awake to disappearance of eyelid reflex), surgical time (time from scope insertion to withdrawal), PACU monitoring time, and physician satisfaction were recorded for both groups. Mean arterial pressure (MAP) and heart rate (HR) were recorded before anesthesia (T0), during scope insertion (T1), and at scope withdrawal (T2) for both groups. The incidence of adverse events such as sedation failure, accidental intubation, nausea/vomiting, and aspiration was recorded. All observations and recordings were performed by anesthetic nurses who were unaware of the group assignments. And the satisfaction of gastroenterologists and anesthesiologists was evaluated.

1.5 Statistical methods

SPSS 22.0 software was used for analysis. Normally distributed measurement data were expressed as $\bar{x} \pm s$, and repeated measures analysis of variance was used for comparison between different time points and within groups. Counting data were expressed as examples, and the chi-square test was used for comparison. $P < 0.05$ was considered statistically significant.

2 Results

2.1 General Information

All of 138 patients included in the study completed the study successfully. The examination time was (8.10±

1.66) min in group C and (7.74±1.39) min in group S. The difference between the two groups was not statistically significant (P>0.05).

2.2 MAP and HR

There were statistically significant differences in the time effects and interaction effects of MAP between the two groups (P<0.05), while the between-group effect was not statistically significant (P>0.05). Pairwise comparisons showed that at T1, the MAP in the group C was significantly lower than in the group S (P<0.05). Similarly, there were statistically significant differences in the time effects, between-group effects, and interaction effects of HR between the two groups (P<0.05). Pairwise comparisons showed that at T1, the HR in the group C was significantly higher than in the group S (P<0.05). **See Table 1**.

Tab.1 Changes of MAP and HR in the two groups（n=69, $\bar{x}\pm s$）

Group	Indicator	T0	T1	T2
Group C	MAP (mmHg)	87.95±10.37	83.91±9.21[a]	88.10±8.79
Group S	MAP (mmHg)	88.00±10.06	87.14±9.77[b]	87.28±9.55
$F_{group}/F_{time}/F_{interation}$ **value**			32.99/0.27/20.89	
$P_{group}/P_{time}/P_{interation}$ **value**			<0.001/0.608/<0.001	
Group C	HR	79.00±7.84	81.58±8.40[a]	78.43±7.87
Group S	HR	78.35±10.41	77.93±10.34[b]	77.65±10.17
$F_{group}/F_{time}/F_{interation}$ **value**			16.65/5.36/23.52	
$P_{group}/P_{time}/P_{interation}$ **value**			<0.001/0.024/<0.001	

Note: Compared with the T0 time in this group, [a]P < 0.05; Compared with group C at the same time, [b]P < 0.05.

2.3 Anesthesia-related indicators

The incidence of hypoxemia in the group S was significantly lower than that in the group C [34.78% (24/69) *vs* 56.52% (39/69), χ^2=6.571, P=0.010]. The induction time of anesthesia in the group S was shorter than that in the group C [(23.17±2.57) s *vs* (24.71±2.12) s, t=3.840, P<0.01]. Compared to the group C, patients in the group S had shorter post-anesthesia care unit (PACU) monitoring times [(14.74±1.46) s *vs* (17.06±1.87) s, t=8.123, P<0.01], higher satisfaction rates among gastroenterologists [89.86% (62/69) vs 75.36% (52/69), χ^2=5.044, P=0.025], and higher satisfaction rates among anesthesiologists [92.75% (64/69) *vs* 71.01% (49/69), χ^2=10.991, P=0.001].

2.4 Adverse events

There were 9 cases of nausea and vomiting in the group C and 5 cases in the group S, with no other adverse events reported.

3 Disscission

During painless gastroscopy, hypoxemia caused by transient respiratory depression and airway obstruction is common, especially in obese patients. Changes in the anatomical structure of the airway, reduced functional residual capacity of the lungs, and decreased compliance of the chest wall in obese patients predispose them to hypoxemia [12]. Additionally, due to the lipophilicity of propofol, obese patients require higher doses for sedation [13]. Therefore, anesthesia management for obese patients undergoing painless gastroscopy poses specific challenges, necessitating the search for effective and safe anesthetic drugs.

Remimazolam is a benzodiazepine with rapid onset, rapid metabolism, and mild suppression of circulatory and respiratory functions. Its sedation success rate is comparable to propofol, with fewer adverse events [14-15]. As it lacks analgesic effects, it is often used in combination with analgesics [16-18]. Esketamine is an anesthetic drug that provides both sedation and analgesia, with rapid onset, potent anesthetic efficacy, rapid metabolism, and high controllability. It has minimal impact on the cardiovascular and respiratory systems of patients and has a sympathomimetic effect on bronchial smooth muscle, promoting bronchodilation and improving respiratory depression [19]. Studies have shown that esketamine can reduce adverse events during painless gastrointestinal endoscopy, such as hypotension and hypoxemia [20-21]. However, research on obese patients is limited. This study investigated the effectiveness and safety of remimazolam and esketamine in combination for painless gastroscopy in obese patients.

Research by De Cosmo et al. [22] demonstrated that the sedative potency of remimazolam was similar to propofol, with minimal effects on the circulatory system, resulting in minimal fluctuations in blood pressure and HR, and stable hemodynamics, consistent with the findings of this study. The shorter anesthesia induction time in the group S may be attributed to the sedative effects of esketamine. The lower incidence of hypoxemia in the group S, along with significantly lower MAP and higher HR in the group C at T1, indicates that the combination of remimazolam and esketamine can significantly reduce respiratory depression and have minimal effects on the circulatory system. Both

remimazolam and esketamine have rapid metabolism characteristics. The shorter PACU monitoring time and higher satisfaction among gastroenterologists and anesthesiologists in the group S may be due to the higher incidence of hypoxemia in the group C, leading to more interruptions during gastroscopy, and the more stable vital signs in the S group, among other factors.

This study has specific limitations. For safety reasons, patients with BMI >40 kg/m2 and ASA classification > grade II were not included, limiting the sample size and generalizability of the study. Additionally, the changes in pulse oximetry during anesthesia were not recorded for both groups.

In summary, the results of this study indicate that the combination of remimazolam and esketamine can reduce respiratory depression and maintain hemodynamic stability. This anesthesia protocol may be more effective and safer for painless gastroscopy in obese patients.

Conflict of Interest: None

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·论　著·

艾司氯胺酮复合瑞马唑仑在肥胖患者无痛胃镜中的应用

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摘要：目的　评价在肥胖患者无痛胃镜中应用艾司氯胺酮复合瑞马唑仑的效果和安全性。**方法**　选择 2022 年 1 月至 12 月南京医科大学第四附属医院和南京市第一医院择期行无痛胃镜的患者 138 例，采用随机数字表法随机分为两组：艾司氯胺酮+瑞马唑仑组（S 组，$n=69$）和丙泊酚+瑞芬太尼组（C 组，$n=69$）。比较两组患者术中低氧血症发生率，麻醉诱导时间、检查时间、麻醉后监护室（PACU）监护时间以及医师满意度。记录两组患者麻醉前（T_0）、进镜时（T_1）以及退镜时（T_2）的平均动脉压（MAP）、心率（HR）并记录不良事件发生情况。**结果**　S 组患者低氧血症发生率明显低于 C 组[34.78%（24/69）*vs* 56.52%（39/69），$\chi^2=6.571$，$P=0.010$]，麻醉诱导时间短于 C 组[（23.17±2.57）s *vs*（24.71±2.12）s，$t=3.840$，$P<0.01$]。与 C 组相比，S 组患者的 PACU 监护时间较短[（14.74±1.46）s *vs*（17.06±1.87）s，$t=8.123$，$P<0.01$]、消化内科医生满意度[89.86%（62/69）*vs* 75.36%（52/69），$\chi^2=5.044$，$P=0.025$]与麻醉医生满意度[92.75%（64/69）*vs* 71.01%（49/69），$\chi^2=10.991$，$P=0.001$]较高。T_1 时 C 组 MAP 显著低于 S 组、HR 显著高于 S 组（$P<0.05$）。C 组有 9 例患者出现恶心呕吐、S 组有 5 例患者出现恶心呕吐，无其他不良事件发生。**结论**　与丙泊酚复合瑞芬太尼相比，瑞马唑仑复合艾司氯胺酮应用于肥胖患者无痛胃镜检查时，低氧血症发生率降低，安全性较高。

关键词：无痛胃镜；肥胖；瑞马唑仑；艾司氯胺酮；丙泊酚；瑞芬太尼；平均动脉压；恶心；呕吐

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gastroenterologists[89.86%(62/69) *vs* 75.36%(52/69), $\chi^2=5.044$, $P=0.025$] and satisfaction of anesthesiologists [92.75%(64/69) *vs* 71.01%(49/69), $\chi^2=10.991$, $P=0.001$] was significantly higher. At T_1, MAP in Group C decreased compared to group S, while HR increased compared to group S ($P<0.05$). Nausea and vomiting occurred in 9 patients in group C and 5 patients in group S, and no other adverse event occurred. **Conclusion** Compared with propofol combined with remifentanil, remimazolam combined with eszketamine for painless gastroscopy in obese patients can reduce the incidence of hypoxemia and has higher safety.

Keywords: Painless gastroscopy; Obesity; Remimazolam; Esketamine; Propofol; Remifentanil; Mean arterial pressure; Nausea; Vomiting

随着健康意识的提高,越来越多的人在胃镜检查时选择无痛胃镜。鉴于对安全舒适的胃肠镜检查需求的增加,临床中需要探索针对特定高危人群的最佳镇静策略,例如对肥胖患者。目前,在胃肠镜检查中肥胖患者的最佳麻醉方案尚未达成一致。丙泊酚联合短效阿片类药物是目前胃镜检查的首选麻醉方案,因为它具有可靠的镇静和镇痛作用。然而,丙泊酚会引起呼吸和循环抑制[1-2],并且还会出现注射痛[3]。另外阿片类药物也会引起呼吸抑制。由于功能残气量减少、胸壁顺应性降低,肥胖患者在无痛胃肠镜过程中很容易发生低氧血症[4]。瑞马唑仑是一种新的苯二氮䓬类药物,作用于中枢神经系统 γ 氨基丁酸(GABA)A 受体,产生镇静遗忘作用[5]。它具有起效时间短、代谢快以及不受输注时间影响的特点[6]。并且其镇静作用可以通过特异性拮抗剂逆转[7]。瑞马唑仑和丙泊酚具有相似的镇静作用。前者在呼吸抑制和低血压发生率方面具有更高的安全性[8]。艾司氯胺酮是一种非竞争性 N-甲基-D-天冬氨酸(N-methyl-D-aspartatic acid,NMDA)受体拮抗剂,其麻醉效果约为氯胺酮的两倍,具有较少的精神副作用以及较高的清除率[9],其镇痛效果强,起效快,对呼吸功能无明显影响[10]。尽管如此,在肥胖患者胃镜检查中使用艾司氯胺酮复合瑞马唑仑的效果和安全性尚无明确的结论。本研究对此作一探讨。

1　资料与方法

1.1　*研究设计*　本研究为单中心、双盲、前瞻性、随机对照研究。本研究已获得医院伦理委员会批准(审批号:20230707-k139),所有患者均签署知情同意书。根据预试验结果,使用 PASS11.0 软件计算样本量,以低氧血症发生率为主要研究指标。C 组发生率约为 54%,S 组约为 30%。假设双侧 $\alpha=0.05$,检验效能 $1-\beta=0.80$,共需要患者 124 例。考虑到脱落率 10%,需纳入 138 例患者。

1.2　*一般资料*　选择 2022 年 1 月至 12 月南京医科大学第四附属医院和南京市第一医院择期行无痛胃镜检查的患者 138 例,年龄 18~65 岁、身体质量指数(BMI)30~40 kg/m^2、美国麻醉医师协会(ASA)分级Ⅱ级。排除标准:严重打鼾和睡眠呼吸暂停;高血压控制不佳;药物过敏史;长期阿片类药物使用史;严重肝肾功能障碍;精神类疾病史;无法配合等。采用随机数字表法将患者随机分为两组:艾司氯胺酮+瑞马唑仑组(S 组)和丙泊酚+瑞芬太尼组(C 组),各 69 例。C 组男 40 例,女 29 例;年龄(41.57±8.71)岁;BMI(33.67±1.82)kg/m^2。S 组男 37 例,女 32 例;年龄(40.83±8.72)岁;BMI(33.34±1.51)kg/m^2。两组患者一般情况差异无统计学意义($P>0.05$)。

1.3　*方法*　患者常规禁食禁水,入室后开放静脉通道,取左侧卧位、常规心电监护。所有患者使用鼻导管吸氧,起始氧流量为 2~4 L/min,吸氧 1~2 min 后,根据患者的校正体重(理想体重+0.4×[总体重−理想体重])给药。C 组给予丙泊酚 1.5 mg/kg(10 mg/mL)、瑞芬太尼 1 μg/kg(4 μg/mL)诱导麻醉;S 组给予瑞马唑仑 0.1 mg/kg(1 mg/mL)、艾司氯胺酮 0.5 mg/kg(5 mg/mL)诱导麻醉。丙泊酚以及瑞马唑仑均以0.5 ml/s 的速度缓慢注射,直到睫毛反射消失。眼睑反射消失后开始胃镜检查。在胃镜检查期间,患者出现吞咽反射或改良观察者的警觉/镇静(modified observer's assessment of alterness/sedation, MOAA/s)评分>2 时,则追加丙泊酚 1 mg/kg 或瑞马唑仑 0.05 mg/kg,必要时重复该过程。镇静失败被定义为初始剂量后镇静不足,并在 15 min 内需要追加四次丙泊酚/瑞马唑仑。根据脉搏血氧饱和度(SpO_2)值以及其持续时间采取对应的措施[11]:当 $SpO_2<90\%$时,立即增加氧流量至 6 L/min;当 $SpO_2<90\%$、持续时间大于15 s 时,立即给予托下颌及挤压胸廓辅助呼吸;当 $SpO_2<90\%$ 持续时间>30 s 或 $SpO_2<85\%$时,立即面罩加压给氧直到 SpO_2 恢复至检查前水平,如果低氧血症仍不能改善则紧急气管插管。术毕停用所有药物。术后患者送入麻醉后监护室(post-anesthesia care unit, PACU),当患者的 Aldrete 评分≥9 或等于术前水平时,允许患者离开

PACU。所有胃镜检查均由同一消化内科医生完成，所有麻醉均由同一麻醉医生完成。

1.4　观察指标　记录两组患者术中低氧血症发生率，即 $SpO_2 \leqslant 90\%$；记录两组患者麻醉诱导时间（指患者从清醒到眼睑反射消失所需时间）、手术时间（指从进镜到退镜所需时间）、PACU 监护时间以及医师满意度；同时记录两组患者麻醉前（T_0）、进镜时（T_1）以及退镜时（T_2）的平均动脉压（MAP）、心率（HR）；记录不良事件发生率，例如镇静失败、意外插管、恶心呕吐以及反流误吸。所有指标观察和记录由不知晓分组的麻醉护士完成。并评价消化内科和麻醉科医生满意度。

1.5　统计学方法　采用 SPSS 22.0 软件进行分析。正态分布的计量资料以 $\bar{x}\pm s$ 表示，不同时点时间及组内比较采用重复测量数据方差分析；计数资料以例表示，比较采用 χ^2 检验。$P<0.05$ 为差异有统计学意义。

2　结　果

2.1　一般情况　本研究共纳入 138 患者，均顺利完成研究。C 组检查时间（8.10±1.66）min，S 组检查时间（7.74±1.39）min，两组差异无统计学意义（$P>0.05$）。

2.2　MAP 和 HR　两组 MAP 时间效应、交互作用差异有统计学意义（$P<0.05$），而组间效应差异无统计学意义（$P>0.05$）；因交互效应显著，进一步分析了简单主效应，结果两两比较显示，T_1 时 C 组 MAP 显著低于 S 组（$P<0.05$）。两组 HR 时间效应、组间效应、交互作用差异有统计学意义（$P<0.05$）；两两比较显示，T_1 时 C 组 HR 显著高于 S 组（$P<0.05$）。见表 1。

2.3　麻醉相关指标　S 组低氧血症发生率明显低于 C 组［34.78%（24/69）*vs* 56.52%（39/69），$\chi^2=6.571$，$P=0.010$］。S 组患者麻醉诱导时间短于 C 组［（23.17±2.57）s *vs*（24.71±2.12）s，$t=3.840$，$P<0.01$］。与 C 组相比，S 组患者的 PACU 监护时间较短［（14.74±1.46）s *vs*（17.06±1.87）s，$t=8.123$，$P<0.01$］、消化内科医生满意度［89.86%（62/69）*vs* 75.36%（52/69），$\chi^2=5.044$，$P=0.025$］与麻醉医生满意度［92.75%（64/69）*vs* 71.01%（49/69），$\chi^2=10.991$，$P=0.001$］较高。

表 1　两组患者 MAP 和 HR 的变化　（$n=69$，$\bar{x}\pm s$）

Tab. 1　Changes of MAP and HR in the two groups　（$n=69$，$\bar{x}\pm s$）

组别	指标	T_0	T_1	T_2
C 组	MAP（mmHg）	87.95±10.37	83.91±9.21[a]	88.10±8.79
S 组	MAP（mmHg）	88.00±10.06	87.14±9.77[b]	87.28±9.55
$F_{时间}/F_{组间}/F_{交互}$ 值			32.99/0.27/20.89	
$P_{时间}/P_{组间}/P_{交互}$ 值			<0.001/0.608/<0.001	
C 组	HR（次/min）	79.00±7.84	81.58±8.40[a]	78.43±7.87
S 组	HR（次/min）	78.35±10.41	77.93±10.34[b]	77.65±10.17
$F_{时间}/F_{组间}/F_{交互}$ 值			16.65/5.36/23.52	
$P_{时间}/P_{组间}/P_{交互}$ 值			<0.001/0.024/<0.001	

注：与本组 T_0 时点比较，[a]$P<0.05$；与 C 组同时点比较，[b]$P<0.05$。

2.4　不良事件　C 组有 9 例患者出现恶心呕吐、S 组有 5 例患者出现恶心呕吐，无其他不良事件发生。

3　讨　论

在无痛胃镜检查中，由短暂的呼吸抑制和气道阻塞引起的低氧血症很常见，尤其是在肥胖患者中。由于肥胖患者气道解剖结构的改变、肺功能性残气量的减少和胸壁顺应性的降低导致其很容易出现低氧血症[12]。另外由于丙泊酚的亲脂性，其在肥胖患者中的分布体积较高，使得肥胖患者镇静所需的丙泊酚剂量较高[13]。因此，在无痛胃镜检查中对肥胖患者进行麻醉管理具有一定的挑战性。有必要寻求有效且安全的麻醉药物用于接受无痛胃镜检查的肥胖患者。

瑞马唑仑是一种苯二氮䓬类药物，具有起效快、代谢快、对循环和呼吸功能抑制轻的特点。瑞马唑仑的镇静成功率不低于丙泊酚，且不良事件发生率较低[14-15]。由于其没有镇痛作用，因此经常与镇痛药联合使用[16-18]。艾司氯胺酮是一种同时具有镇静镇痛作用的麻醉药物，具有起效快、麻醉效力强、代谢快、可控性高的特点。它对患者循环和呼吸系统功能的影响较轻。艾司氯胺酮对支气管平滑肌具有拟交感作用，可使支气管扩张，从而改善呼吸抑制[19]。有研究表明，艾司氯胺酮可以减少无痛胃肠镜检查中的不良事件，如低血压和低氧血症[20-21]。然而，针对肥胖患者的相关研究甚少。本研究在肥胖患者无痛胃镜检查中联合使用瑞马唑仑及艾司氯胺酮，探讨其有效性和安全性。

De Cosmo 等[22]研究显示，瑞马唑仑镇静强度与丙泊酚相当，对循环系统的影响较小，血压和 HR 波动范围较小，血流动力学稳定，本研究结果与其相似。本研究中 S 组患者麻醉诱导时间短于 C 组，这可能与艾司氯胺酮有一定镇静作用有关；S 组低氧血症发生率更低，T_1 时 C 组 MAP 显著低于 S 组、HR 显著高于 S 组，说明瑞马唑仑与艾司氯胺酮联合用药可明显减轻患者的呼吸抑制、对循环系统影响较小。瑞马唑仑与艾司氯胺酮都具有代谢快的特点。本研究 S 组患者的 PACU 监护时间较 C 组明显减少，消化内科

医生与麻醉医生满意度较 C 组明显增高,可能是由于 C 组低氧血症发生率较高,导致胃镜检查中断次数多,以及 S 组生命体征更平稳等因素。C 组有 9 例患者出现恶心呕吐、S 组有 5 例患者出现恶心呕吐,无其他不良事件发生。

本研究存在一定局限性,出于安全考虑,未包括 BMI>40 kg/m^2 以及 ASA 分级>Ⅱ级的患者,这限制了样本量的纳入和研究的可推广性;另外没有记录两组患者麻醉期间 SpO_2 的变化趋势。

综上所述,本研究结果表明,瑞马唑仑与艾司氯胺酮联用可减少呼吸抑制的发生、维持血流动力学稳定性,此麻醉方案可能是一种更有效、更安全的方案,适用于肥胖患者的无痛胃镜检查。

利益冲突　无

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