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Intraoperative lidocaine infusion as a sole analgesic agent versus morphine in laparoscopic gastric bypass surgery

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Abstract

Background: The aim of this study was to assess the effect of intra-operative intra-venous (IV) lidocaine infusion compared to IV morphine, on the post-operative pain at rest, the intra-operative and post-operative morphine requirements, the sedation and the Modified Aldrete scores in the post-anesthesia care unit (PACU), the hemodynamic parameters; mean values of the mean blood pressure (MBP) and the heart rate (HR), the peri-operative changes in the SpO_2, and the respiratory rate (RR) in laparoscopic Roux-en-y gastric bypass. Sixty patients ˃ 18 years old, with body mass index (BMI) ˃ 35 kg/m^2, American Society of Anesthesiologists (ASA) physical status II or III, were randomly divided into 2 groups: the lidocaine (L) group patients received intra-operative IV lidocaine infusion, and the morphine (M) group patients received intra-operative IV morphine.

Results: The post-operative numeric pain rating scale (NPRS) at rest was statistically significant less in group L than in group M patients, in the post-operative 90 min in the PACU. This was reflected on the post-operative morphine requirements in the PACU, as 26.6% of patients in group M required morphine with a mean total dose of 10.8 mg. The mean values of the MBP and HR recorded after intubation were comparable between patients of both groups, indicating attenuation of the stress response to endotracheal intubation by both lidocaine and morphine. However, the mean values of the MBP and HR recorded after extubation were statistically significant lower in patients of group L, indicating the attenuation of the stress response to extubation by lidocaine. Patients in group M showed statistically significant lower mean values of the MBP; before pneumoperitoneum and after 15 min from the pneumoperitoneum, this was reflected on statistically significant higher mean values of the HR. Patients in group L showed statistically significant lower mean values of the MBP and the HR; at 30 and 45 min from the pneumoperitoneum. Patients in group L showed statistically significant lower mean values of the MBP; 60 min from the pneumoperitoneum, after release of pneumoperitoneum and in the PACU. Patients of both groups showed comparable mean values of the HR after 60 min from the pneumoperitoneum, after release of the pneumoperitoneum and in the PACU. No patient in either groups developed post-operative respiratory depression in the PACU. Patients in group L showed statistically significant higher median sedation score, which was reflected on statistically but not clinically significant less Modified Aldrete score in patients of group L.

Conclusions: In morbid obese patients, the intra-operative IV lidocaine infusion offered post-operative analgesia in the PACU, on the expense of a higher sedation score, which didn't affect the Modified Aldrete score clinically, with attenuation of the stress response to endotracheal intubation and extubation.

Trial registrations

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FMASU R16/2021. Registered 1st February 2021, with Clinical Trials Registry (NCT05150756) on 10/08/2021.
Keywords: Morbid obesity, Lidocaine infusion, Morphine, Post-operative analgesia, Modified Aldrete score

Background

Obesity is a chronic illness with increasing incidence in adults, adolescents and children. Laparoscopic Roux-en-Y gastric bypass is the procedure of choice for morbid obese patients (Vincent et al. 2017). Obesity complicates the anesthetic management and opioid use (Seet and Chung, 2010; Mulier, 2016; ÇOK, 2017). Co-existence of obstructive sleep apnea, increases the incidence of hypoventilation, hypoxemia, and sedation (Shapiro et al. 2005; Lee et al. 2007; Ingrande and Lemmens, 2010), with a resultant under treatment of post-operative pain with opioids. Also, neuraxial analgesia and peripheral nerve blocks are technically difficult in obese patients (Parra and Loftus, 2013) so, alternative post-operative analgesic approaches should be available (Eipe and Budianski, 2018).

Lidocaine is a short acting amino amide local anesthetic for continuous IV administration, it has a very short half-life and a good safety profile (Lauren and Marcel, 2017; Weibel et al. 2018), with persistence of the analgesic effect for 5.5 times its half-life (˃ 8.5 h) (Barreveld et al. 2013) after decrease in its plasma concentration to 0.1 μM (Hollmann et al. 2002), after stoppage of the infusion (Koppert et al. 2004; De Oliveira et al. 2015) and its metabolism to Monoethylglycinexylidide (MEGX), which exerts an analgesic effect (De Klaver et al. 2003; Ibrahim et al. 2018) and glycinexylidide (GX) which decreases lidocaine metabolism; both are metabolized and excreted by the kidney (Eipe et al. 2016). The analgesic effect for visceral pain occurs by directly blocking the sodium channels of the pain conducting nerve fibers (De Oliveira et al. 2014; Obreja et al. 2012), inhibition of an intracellular G-protein signaling molecule (Gq) (Hollmann et al. 2004; Dunn and Durieux, 2017), blocking of the post-synaptic depolarization of the N-methyl-d-aspartate (NMDA) receptor (Kuo et al. 2006; Kaba et al. 2007) and attenuating the pro-inflammatory effects; by blocking the priming of the polymorphonuclear leukocyte with decrease of the production of cytokines and reactive oxygen species; decreasing the damage of the endothelium thus the vascular and organ injury (Leliefeld et al. 2016), decreasing the need for intra-operative volatile anesthetic and/or opioids; thus decreasing secondary post-surgical hyperalgesia and central sensitization of the spinal cord neurons (Petrenko et al. 2012; Cho et al. 2013; Hamp et al. 2013) and attenuating the sympathetic responses (Eipe et al. 2016; Kandil et al. 2017).

The aim of the current study was to assess the effect of intra-operative IV lidocaine infusion as a sole analgesic; on the post-operative pain score at rest, the sedation and the Modified Aldrete scores in the PACU, as well as the hemodynamic changes with pneumoperitoneum in comparison to morphine.

Methods

After obtaining the approval of the ethical committee of Faculty of medicine, Ain-Shams University (FMASU R35/2021), informed consent was taken from 60 patients ≥ 18 years old, with ASA physical status II–III, BMI ˃ 35 kg/m^2 and scheduled to undergo laparoscopic Roux-en-y gastric bypass at Ain-Shams University Hospitals. Simple randomization was done using computer generated random number tables with sealed opaque envelopes.

Exclusion criteria

Patients' refusal, hypersensitivity to the study medications, patients with known history of hepatic disease, severe renal impairment (estimated glomerular filtration rate: eGFR < 30 ml/min/1.73 m^2), seizure disorder, heart failure; left ventricular ejection fraction < 35%, any cardiac dysrhythmias; Adam-Stokes syndrome; Wolff-Parkinson-White syndrome, atrio-ventricular block with heart rate < 50 beat per minute (bpm), hypertensive patients on beta blocking drugs, chronic pain, or substance abuse (Fig. 1).

Pre-operative evaluation included history taking, physical examination, and investigations; complete blood count, the coagulation profile, liver and kidney functions tests, electrocardiography (ECG), and echocardiography (Echo). Preoperative fasting instruction was nothing per orally 8 h for solids and 2 h for clear fluids. Also, during the pre-anesthetic visit, the NPRS for pain assessment was explained to the patients.

Preparation of the study drugs

The loading doses of 2% Lidocaine hydrochloride (Sigma Tec Industries, Co-packed by Al-Debeiky pharmaceutical Industries, Obour City Ind Zone, A.R.E.) or morphine sulphate (10 mg/ml; Misr Co For pharmaceuticals, Alexandria, Egypt); calculated according to the patient's body weight and diluted to a 10-ml syringes, were prepared and labeled as loading-1 and loading-2 respectively.

Also, 2 syringes of 50 ml volume; containing 2% Lidocaine hydrochloride or 0.9% sodium chloride (normal

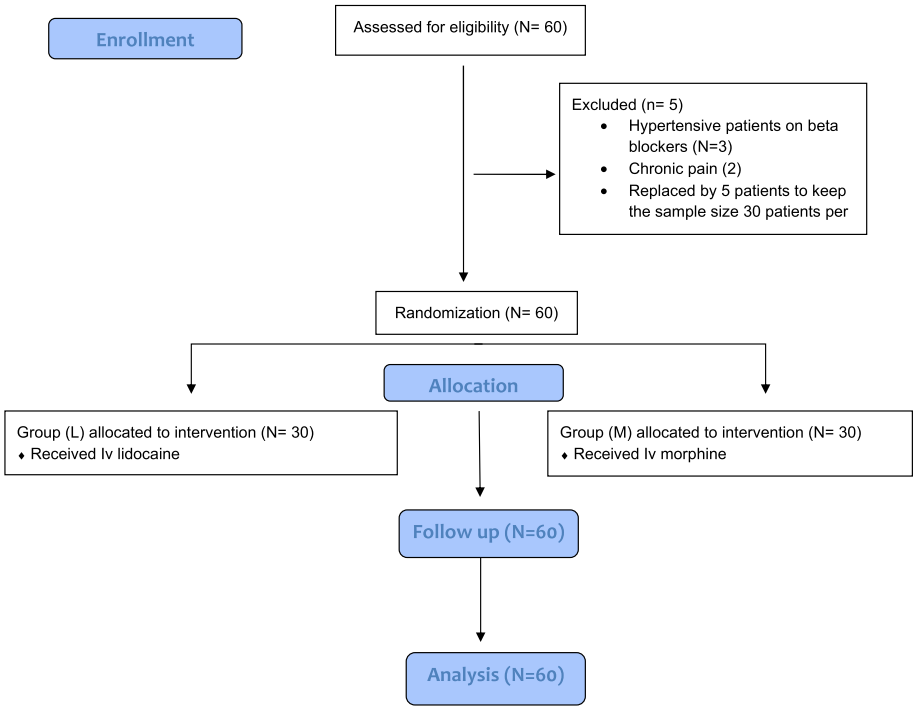

Fig. 1 Flow chart for patients' enrollment and allocation

saline NS) infusion labeled as infusion-1 and infusion-2 respectively were also prepared.

The anesthetic technique

In the induction room, patients had an 18 G intravenous cannula inserted in the dorsum of the hand. Patients were preloaded with 10 ml/kg of Ringer acetate solution, until the start of the abdominal insufflation. One milligram granisetron (Granitryl 1 mg/ml; Alex Co, for Egy-pharma, Egypt) and 40 mg pantoprazole sodium (Controloc 40 mg IV vial; Takeda GmbH, D-78224 Singen, Germany) were given. On arriving to the operating theater five-leads ECG, non-invasive blood pressure, and pulse oximetry monitoring were started, using General electric-Dash 5000 (GE Medical Systems Information Technologies Inc., Milwaukee, WI, USA). Capnography was connected with induction of anesthesia. Patients were sedated with 0.05 mg/kg midazolam hydrochloride (Dormicum 5 mg/ml; Roche, Basel, Switzerland).

Patients then were divided into 2 equal groups of 30 patients each

Group L

The lidocaine group. At induction of anesthesia, patients received a loading dose of IV 1.5 mg/kg lidocaine hydrochloride 2% slowly over 3 min followed by IV infusion of 2 mg/kg/h lidocaine hydrochloride 2% via infusion pump, through a second IV line secured after induction of anesthesia. The infusion continued till the end of surgery (Eipe et al. 2016; Dunn and Durieux, 2017).

Group M

The morphine group. At induction of anesthesia, patients received a loading dose of IV 0.1 mg/kg morphine sulfate slowly over 3 min followed by IV infusion of NS via infusion pump, through a second IV line secured after induction of anesthesia. The infusion rate was calculated as for the study group so that both groups received equal volumes of infusion. The infusion continued till the end of surgery (Al-Tamimi et al. 2009).

After proper airway assessment and difficult airway anticipation, pre-oxygenation with 8 L/min of 100% O_2 for 3 min was started; anesthesia with endo-tracheal intubation was induced with, IV 2 mg/kg propofol (Propofol 1%; Fresenius Kabi, Deutschland, GmbH Grazia) and 1 mg/kg rocuronium bromide-hameln (50 mg/5 ml; Sunny Pharmaceutical).

Maintenance of anesthesia was done with oxygen (4 L/min of 60% O_2 in air) and 2% sevoflurane, further neuromuscular blockade was maintained with intermittent boluses of 0.1 mg/kg rocuronium bromide every 30 min. One gram paracetamol (Perfalgan vial; 100 ml of 10 mg/ml) was IV infused over 10–20 min. Maintenance rate of Ringer acetate solution (4 ml/kg/h) was IV infused (Idit and Andrei, 2021). Intra-operative

additional IV titrated doses of 2.5–5 mg morphine sulphate with 10 min intervals was given (Choi et al. 2000; Charghi et al. 2003), when needed to maintain the MBP within 20% of the baseline value. Patients were mechanically ventilated by pressure controlled volume guarantee mode (PCVG). Ventilation was adjusted to maintain an end-tidal carbon dioxide ($EtCO_2$) value between 30 and 35 mmHg, positive end expiratory pressure of 5 cm H_2o was added. Pneumoperitoneum was achieved with carbon dioxide and intra-abdominal pressure maintained to 14 mmHg throughout the procedure.

After completion of surgery, neuromuscular blockade was antagonized with IV injection of 2 mg/kg sugammadex (200 mg/2 ml solution; Sunny Pharmaceutical). The trachea was extubated when the patient regained consciousness and patients were transferred to the PACU. 1 g of paracetamol was IV infused over 10–20 min every 8 h. A patient with a NPRS $>$ 3 was given IV bolus of 2 mg morphine sulphate, which was repeated if the NPRS still $>$ 3, with maximum total morphine dose given not exceeding 0.25 mg/kg (Al-Tamimi et al. 2009). The patients were observed for 90 min in the PACU, and then transferred to the surgical unit when the Modified Aldrete score was ≥ 9.

Primary outcome

Post-operative pain score at rest

Intensity of pain was monitored at regular intervals; on arrival to the PACU (0 min), at 30, 60, and 90 min after arrival to the PACU by the NPRS (Closs et al. 2004). The NPRS is a segmented numeric version of the visual analog scale (VAS) in which the patient selects a whole number (0–10 integers) that best reflects the intensity of pain felt (from 0 = no pain, to 10 = worst imaginable pain). The common format is a horizontal bar or line (Fig. 2).

Secondary outcomes

Hemodynamic parameters (MBP and HR) were recorded before induction of anesthesia 5 min after endotracheal intubation, before pneumoperitoneum (PP), 15 min after PP, 30 min after PP, 45 min after PP, 60 min after PP, after release of pneumoperitoneum, and after extubation and in the PACU.

Morphine requirements: number of patients who required intra-operative and post-operative additional morphine doses and the total dose of morphine given.

SpO_2 recorded before induction of anesthesia and in the PACU.

Respiratory rate (RR) recorded before induction of anesthesia and in the PACU.

Post-operative sedation score in the PACU (Chiruvella et al. 2014)

0 = Awake and agitated.

1 = Awake and comfortable.

2 = Asleep and arousable.

3 = Asleep with sluggish response to verbal commands or touch.

4 = No response to verbal command or touch.

The Modified Aldrete Score before discharge from the PACU.

Modified Aldrete score (Aldrete, 1995).

Activity

2 = moves all extremities voluntarily or on command.

1 = moves two extremities voluntarily or on command.

0 = unable to move extremities.

Respiration

2 = breathes deeply and coughs freely.

1 = dyspneic, shallow, or limited breathing.

0 = apneic.

Circulation

2 = BP ± 20 mmHg of pre-anesthetic level.

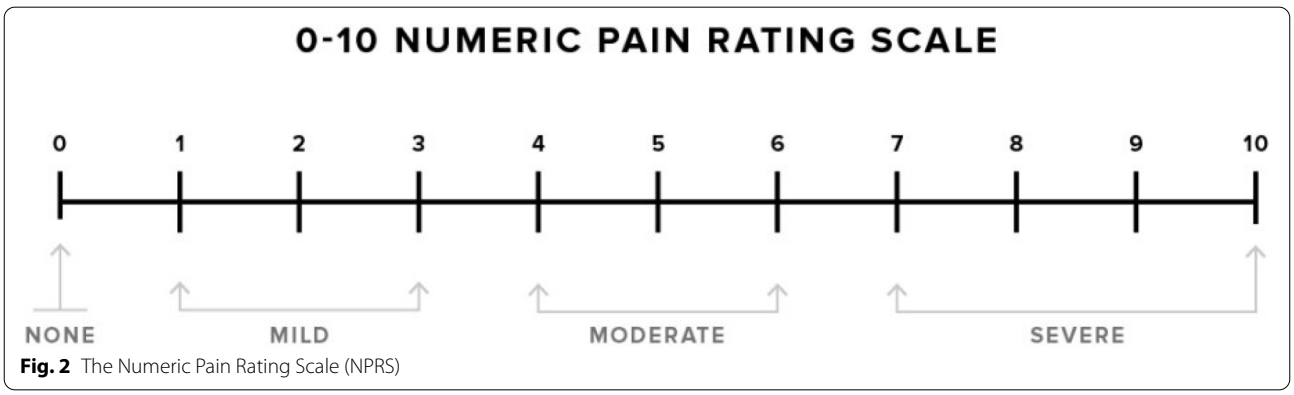

Fig. 2 The Numeric Pain Rating Scale (NPRS)

1 = BP ± 20–50 mm of pre-anesthetic level.
0 = BP ± 50 mm of pre-anesthetic level.

Consciousness

2 = fully awake.
1 = arousable on calling.
0 = not responding.

Oxygen saturation

2 = SpO_2 > 92% on room air.
1 = Supplemental O_2 required to maintain SpO_2 > 90%
0 = SpO_2 < 90% with O_2 supplementation.

Sample size calculation

Sample size calculation was done by G* program, setting alpha error at 5% and power at 80%, reviewing results from the study by Weibel and his colleagues in 2018; which showed the reduced pain score in the lidocaine group compared to the control group was (SMD = 0.5). Based on these results, a sample size of at least 25 patients per group was needed. Five patients were added to each group for possible dropouts so that each group included 30 patients.

Statistical methods

Data were analyzed using Statistical Package for Social Science (SPSS) version 21.0. Chicago, IL, USA. Mean ± standard deviation expressed quantitative data. Count expressed qualitative data. Comparison between means in the two groups was done by the independent-samples *t* test. Median and interquartile range expressed the non-normally distributed data, and independent samples median test applied for analysis. Comparison of proportions between two qualitative parameters was done by the chi-square test. $P < 0.05$ was considered significant.

Results

Sixty patients (30 patients in each group) with comparable age, sex, ASA physical status and BMI; with *P* value 0.108, 0.292, 0.347, and 0.683 respectively (Table 1) were enrolled in the study. The patients were scheduled to undergo laparoscopic Roux-en-y gastric bypass, with comparable mean operative and anesthetic durations, with *P* value 0.443 and 0.111 respectively (Table 2).

Regarding the mean values of the MBP, there was no statistically significant difference between the two groups with respect to; the mean values recorded before induction of anesthesia and after endotracheal intubation, with *P* value 0.075 and 0.546 respectively. However, the mean values of the MBP showed statistically significant lower values in group M than in group L; before pneumoperitoneum and after 15 min from the pneumoperitoneum, with P value 0.036 and 0.001 respectively. At 30, 45, and 60 min from the pneumoperitoneum, after release of pneumoperitoneum, after extubation and in the PACU; the mean values of the MBP showed statistically significant lower values in group L than in group M, with *P* value < 0.001, 0.043, 0.005, < 0.001, < 0.001, and < 0.001 respectively (Fig. 3).

Regarding the mean values of the HR, they were comparable between the two groups before induction of anesthesia, after endotracheal intubation, after 60 min from pneumoperitoneum, after release of the pneumoperitoneum and in the PACU, with *P* value 0.840, 0.308, 0.589, 0.861, and 0.218 respectively. However, the mean values of the HR showed statistically significant lower values in group L than in group M; before pneumoperitoneum, after 15, 30, and 45 min from the pneumoperitoneum and after extubation, with *P* value < 0.001 (Fig. 4).

Regarding the post-operative pain score at rest, the NPRS was statistically significant less in group L than in group M, with *P* value < 0.001. On arrival to the PACU, the median (range) NPRS was 2 (0–3) in group L (40% of patients) and 3 (2–4) in group M (46.6% of patients). After 30 min in the PACU, the median (range) NPRS was 1 (0–3) in group L (36.6% of patients) and 3 (2–4) in group M (50% of patients). After 60 min in the PACU, the median (range) NPRS was 1 (0–3) in group L (53.3% of patients) and 3 (2–4) in group M (60% of patients). After 90 min in the PACU, the median (range) NPRS was 1 (1–2) in group L (73.3% of patients) and 2.5 (2–3)

Table 1 Patient's demographic data

Variables	Groups		*P* value
	M (*N* = 30)	L (*N* = 30)	
Age (years)	42.9 ± 5.38	45.1 ± 5.42	0.108
Sex (female/male)	20/10	16/14	0.292
ASA(II/III)	25/5	22/8	0.347
BMI (kg/m^2)	42.97 ± 3.11	43.4 ± 3.73	0.683

Data are presented as count or mean ± SD. *P* value < 0.05 is statistically significant

M morphine group, *L* lidocaine group

Table 2 The operative and anesthesia durations

Variables	Groups		*P* value
	M (*N* = 30)	L (*N* = 30)	
Duration of surgery (min)	148.1 ± 18.17	151.7 ± 16.93	0.443
Duration of anesthesia (min)	170.4 ± 19.72	178.6 ± 19.68	0.111

Data are presented as mean ± SD. *P* value < 0.05 is statistically significant

M morphine group, *L* lidocaine group

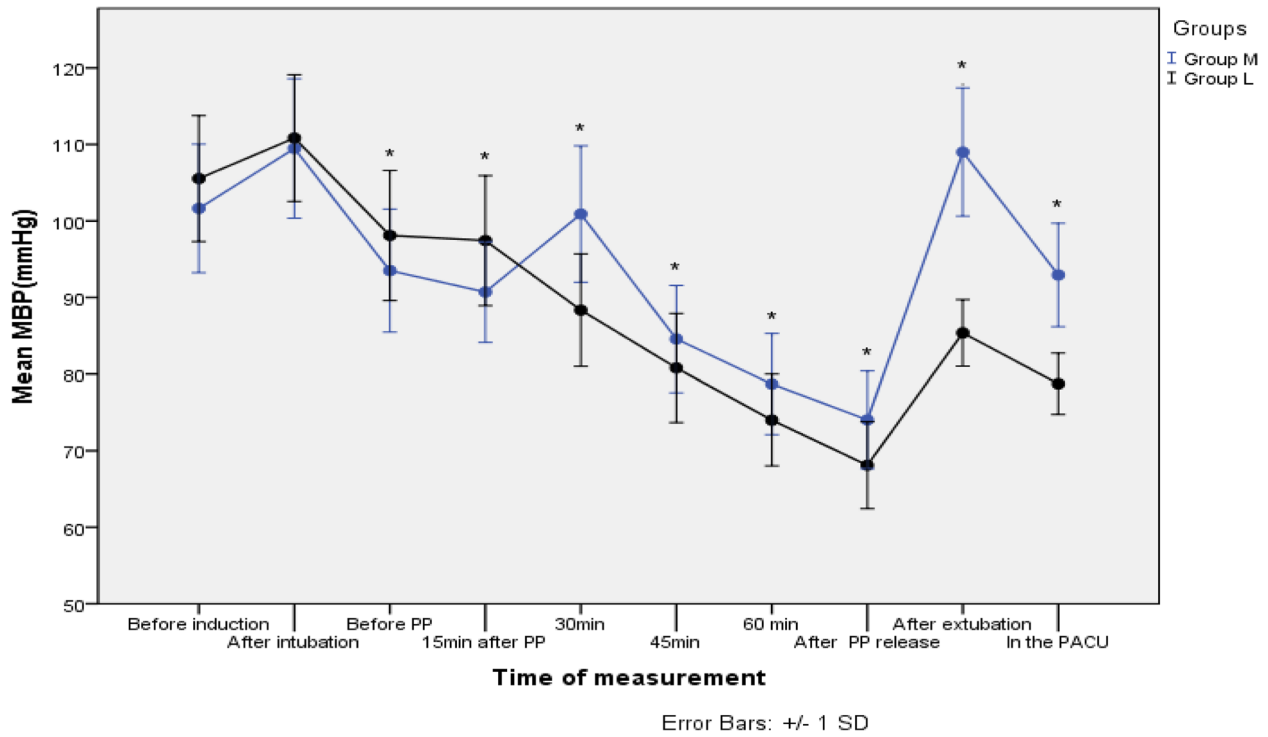

Fig. 3 Mean blood pressure (MBP) at different times of measurements

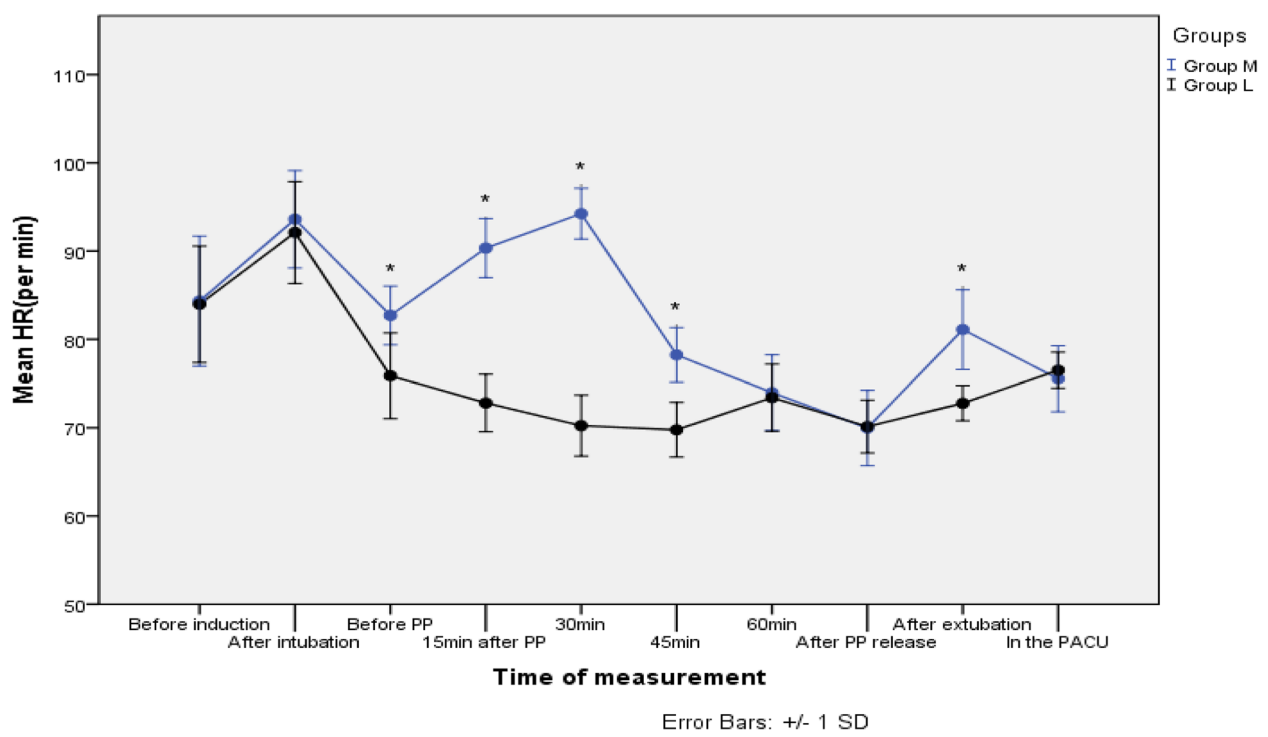

Fig. 4 Heart rate (HR) at different times of measurements

in group M (50% of patients with score 2 and 50% of patients with score 3) (Table 3, Fig. 5).

Regarding the morphine requirements, no patient in group L required intra-operative or post-operative morphine. However, in group M, 2 patients (6.7% of the patients) required 2.5 mg morphine intra-operatively, and 8 patients (26.6% of the patients) required morphine in the PACU. The mean total dose of morphine was 10.8 ± 1.4 mg.

Table 3 Numeric Pain Rating Score (NPRS) in the post-anesthesia care unit (PACU)

Variables	Groups		*P* value
	M (*N* = 30)	L (*N* = 30)	
NPRS on arrival to PACU	3(2–4)	2(0–3)	< 0.001
NPRS after 30 min	3(2–4)	1(0–3)	< 0.001
NPRS after 60 min	3(2–4)	1(0–3)	< 0.001
NPRS after 90 min	2.5(2–3)	1(1–2)	< 0.001

Data are presented as median (range). *P* value ˂ 0.05 is statistically significant

M morphine group, *L* lidocaine group, *NPRS* Numeric Pain Rating Score, *PACU* post-anesthesia care unit

Regarding the post-operative sedation score, patients in group L showed statistically significant higher median sedation score (80% of patients with score 2) than patients in group M (86.6% of patients with score 1), with *P* value < 0.001. This was reflected on the Modified Aldrete score, as the median (range) score was 9 (8–10) in group L (66.6% of patients) and 10 (9–10) in group M (80% of patients), with *P* value < 0.001 (Table 4).

No patient in either group developed post-operative respiratory depression, with *P* value for the mean SpO_2 between the two groups; before induction and in the PACU 0.928 and 0.287 respectively, and with *P* value for the mean RR changes; before induction and in the PACU between the two groups 0.098 and 0.838 respectively in both groups (Table 5).

Discussion

In the current study, the consensus statement of the National Institutes of Health (NIH) in 1991 for patients candidate for Roux-en-y gastric bypass was applied; patients with a BMI ˃ 40 kg/m^2, or patients with a BMI of 35–40 kg/m^2 and have a medical illness like hypertension, diabetes mellitus, dyslipidemias, severe obstructive sleep apnea, obesity-related cardiomyopathy, stress

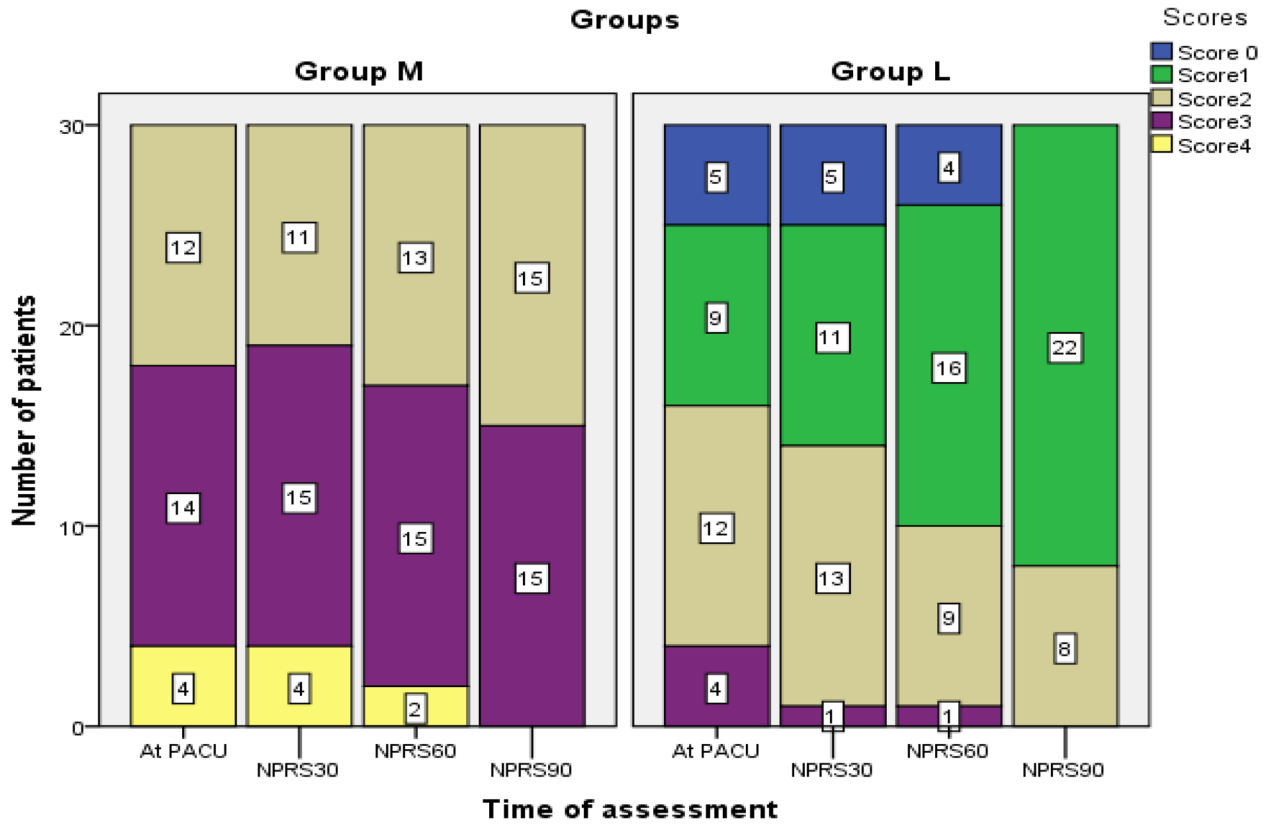

Fig. 5 Frequency distribution of the Numeric Pain Rating Score (NPRS) in the post-anesthesia care unit (PACU)

Table 4 The sedation and the Modified Aldrete scores in the post-anesthesia care unit (PACU)

Variables	Groups		*P* value
	M (*N* = 30)	L (*N* = 30)	
Sedation score	1(1–2)	2(1–2)	< 0.001
Modified Aldrete score	10(9–10)	9(8–10)	< 0.001

Data are presented as median (range). *P* value ˂ 0.05 is statistically significant

M morphine group, *L* lidocaine group, *PACU* post-anesthesia care unit

urinary incontinence, or osteoarthritis interfering with the lifestyle (Secretaria, 2005; Piazza et al. 2011).

In the present study, both lidocaine and morphine attenuated the stress response of intubation, which occurs as a result of adrenaline surge with the stimulation of the pharyngeal, laryngeo-tracheal nociceptors (Aqil, 2014; Swarnamba et al. 2016; Teong et al. 2020). This was reflected on the mean values of the MBP and the HR recorded after intubation. This finding was also demonstrated in the study by Kaba and his colleagues in 2007, Khan and his colleagues in 2008 and the study by Hegazy and his colleagues in 2019. This is explained by the rapid increase in the effective blood concentration of morphine, due to increased opioid metabolism by glucuronidation in obese patients (Leliefeld et al. 2016; Linares et al. 2017), and the rapid achievement of steady state concentration for lidocaine owing to the loading and infusion approach applied (Cassuto et al. 1985, Groudine et al. 1998). Regarding the hemodynamic changes with extubation, lidocaine infusion blunted the stress response to extubation, reflected in the increase in the mean values of the MBP and HR after extubation in the morphine group. This effect was also demonstrated in the study by Kaba and his colleagues in 2007 and Attari and his colleagues in 2017. The hemodynamic changes with extubation results from the tracheal irritation as well as the surgical wound pain with the resultant increase in the release of catecholamines; this results in critical increase in myocardial oxygen demand in patients with increased risk for coronary arterial disease (Hartley and Vaughan, 1993; Kahoru et al. 1995).

Table 5 The SpO_2 and respiratory rate

	Groups		*P* value
	M (*N* = 30)	L (*N* = 30)	
SpO_2 before induction (%)	97.7 ± 1.4	97.7 ± 1.4	0.928
SpO_2 in the PACU (%)	98.6 ± 1.6	98.9 ± 0.8	0.287
RR before induction (bpm)	12.1 ± 0.6	11.8 ± 0.7	0.098
RR in the PACU (bpm)	11.4 ± 0.6	11.4 ± 0.6	0.838

Data are presented as mean ± SD. *P* value ˂ 0.05 is statistically significant

M morphine group, *L* lidocaine group, *PACU* post-anesthesia care unit, *bpm* breath per minute

In the present study, morphine caused statistically significant lower values in the MBP and higher values in the HR, before the pneumoperitoneum and in the first 15 min after pneumoperitoneum; this is attributed to the transient histamine release by morphine, with its vasodilator effect on the small blood vessels, thus decreasing the vascular resistance (Baldo and Pham, 2012). Together with the judicious infusion rate of the IV fluids in obese patients and the decrease in the venous return by the pneumoperitoneum and the reverse Trendelenburg position (Stephanie and Konstantin, 2013). After 30 and 45 min of pneumoperitoneum, there was a statistically significant increase in the MBP and the HR in the morphine group; this could be attributed to the continued neurohumoral effects of pneumoperitoneum (increase norepinephrine, epinephrine and plasma renin levels), the systemically absorbed CO_2 and the reverse Trendelenburg position (Kataria et al. 2016; Kotwani et al. 2017), added to the need for intra-operative analgesia in the morphine group. Patients in the lidocaine group showed hemodynamic stability with pneumoperitoneum; with the decrease in the mean values of the MBP within 20% of the patient's baseline values (Kaba et al. 2007). Also, patients in the lidocaine group showed adequate analgesic effect in terms of statistically significant lower mean HR values. In the PACU, the analgesic effect of lidocaine was manifested by the decrease in the MBP and the HR values due to the lidocaine steady state concentration. This goes with the finding by Koppert and his colleagues in 2004, who reported sustained analgesic effect up to 36 post-operative hours after cessation of the lidocaine infusion.

In the current study, the opioid free protocol for the Enhanced Recovery After Bariatric Surgery (ERABS) approach (Feld et al. 2003; Gildasio et al. 2014), offered acute post-operative analgesia. As patients of the lidocaine group showed lower median NPRS at all times of assessment in the PACU, with a maximum score of 3 (mild pain) and no patient required intra-operative or post-operative morphine. However in the morphine group, 13.3% of patients had NPRS of 4 (moderate pain) on arrival to the PACU and after 30 min. Although this lower NPRS in the lidocaine group was statistically significant, it was clinically non-significant; as the pain was relieved with a mean morphine dose of 0.67 mg in the morphine group. Our results go with those by Vigneault and his colleagues in 2011, Sun and his colleagues in 2012 and Kranke and his colleagues in 2015, who reported reduced cumulative opioid consumption, by 7.4 mg morphine equivalents during the first 24–72 h post-operatively with perioperative lidocaine infusion.

Groudine and his colleagues in 1998, Koppert and his colleagues in 2004 and Feld and colleagues in 2006, reported opioid-free analgesia in morbid obese patients undergoing laparoscopic bariatric surgery; they found comparable post-operative pain scores in the opioid and non-opioid groups, with opioid sparing effect in the PACU in the opioid free group. In patients undergoing bariatric surgery, lidocaine infusion reduced 24-h opioid consumption by 10 mg morphine equivalents compared to placebo with improved recovery scores (De Oliveira et al., 2014). Perioperative lidocaine 1.5 mg/kg bolus followed by 2 to 3 mg/kg/h infusion, decreases post-operative pain and opioids requirements with improved recovery in bariatric surgery (De Oliveira et al. 2014; Cleveland et al. 2015). These effects occur with intravenous infusion rates that mimic plasma concentrations with epidural administration. In 2006, Kuo and colleagues suggested that IV lidocaine offers a useful alternative to epidurals; regarding pain relief and opioid consumption during the 72 h after colonic surgery. In 2011, Wongyingsinn and colleagues confirmed that in laparoscopic colorectal surgery, IV lidocaine ensures the same enhanced recovery after surgery outcomes as continuous epidural infusions.

Patients in the lidocaine group had higher median sedation score of 2 (80% of patients); with patients asleep and arousable than patients in the morphine group with median sedation score of 1 (86.6% of patients); with patients awake and comfortable. Although this is statistically significant, it is clinically non-significant; as this wasn't reflected on the Modified Aldrete score. As patients in the lidocaine group had a median Modified Aldrete score of 9, compared to a median Modified Aldrete score of 10 in patients of the morphine group. Patients who receive peri-operative lidocaine appear to be more sleepy, due to lidocaine blunting the sympathetic responses to tracheal extubation; however, this did not affect time to PACU discharge. In 2006, Feld and his colleagues reported less sedation in the PACU in the opioid free group.

Conclusions

Intra-operative IV lidocaine infusion offers enhanced recovery after bariatric surgery, in terms of acute post-operative analgesia without post-operative respiratory depression, added to its hemodynamic stability effect.

Limitations

The lidocaine level in the blood was not measured, and the neuromuscular block monitoring was not applied in the current study.

Abbreviations

ASA: American Society of Anesthesiologists; BMI: Body mass index; BPM: Beat per minute; ECG: Electrocardiography; Echo: Echocardiography; ERABS: Enhanced Recovery After Bariatric Surgery; EtCO2: End-tidal carbon dioxide; eGFR: Estimated glomerular filtration rate; Gq: G-protein signaling molecule; GX: Glycinexylidide; HR: Heart rate; IV: Intra-venous; L: Lidocaine; M: Morphine; MBP: Mean blood pressure; MEGX: Monoethylglycinexylidide; NIH: National Institutes of Health; NMDA: N -methyl-d-aspartate; NPRS: Numeric pain rating scale; NS: Normal saline; PACU: Post-anesthesia care unit; PCVG: Pressure controlled volume guarantee mode; RR: Respiratory rate; VAS: Visual analog scale.

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Author contributions

MG designed the study, revised literature, and reviewed the manuscript. GS design of the work, revised literature, performed the analysis, revised the statistical analysis, and wrote the manuscript. DA followed the patients and collected the data. All authors approved the final version of the manuscript. All authors have contributed intellectually to the manuscript and the manuscript has been read and approved by all the authors. The manuscript have not been published, simultaneously submitted, or accepted for publication elsewhere. All authors read and approved the final manuscript.

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Availability of data and materials

The datasets generated and/or analyzed during the current study are not publicly available due [publishing the clinical data about any study conducted in our hospitals and approved by the institutional ethical committee is against the policy of the Faculty of Medicine, Ain Shams University, unless there is a reasonable request] but are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

Approval of research ethical committee of Faculty of Medicine, Ain-Shams University was obtained (FMASU R35/2021) and written informed consent was obtained from the patients after description of the procedure. The study was registered with Clinical Trials Registry (NCT05150756) on 10/08/2021.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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