

1 **Comparison of the Effect of Intraoperative 1 mg/kg/h and 2 mg/kg/h IV Lidocaine**
2 **Infusion on Postoperative Pain and Nausea-Vomiting in Laparoscopic Gastric**
3 **Bypass Surgery**

4 **Objective:** To relieve postoperative pain and nausea and vomiting, various drugs and
5 methods, including intraoperative IV lidocaine infusion in different surgeries. However, the
6 exact same dose has not yet been determined. The purpose of this study was to evaluate and
7 compare the effect of intraoperative 1 mg/kg/h and 2 mg/kg/h IV lidocaine infusion on
8 postoperative pain and nausea-vomiting in laparoscopic gastric bypass surgery.

9 **Methods:** This clinical trial study was performed on patients undergoing laparoscopic
10 gastric bypass surgery in Rasoul-e-Akram Hospital, Iran. Patients were randomly assigned
11 into two groups (1 mg/kg/h lidocaine) and (2 mg/kg/h lidocaine). Postoperative pain and
12 nausea and vomiting were evaluated at times 0, 30 min, 1 h, 6 h, 12 h and 24 h after surgery.
13 Data was analyzed using statistical tests and SPSS 22.

14 **Results:** There was no significant difference in the effect of intraoperative 1 mg/kg/h and 2
15 mg/kg/h IV lidocaine infusion on static and dynamic pain and nausea-vomiting, agitation,
16 systolic BP, diastolic BP, pulse rate and postoperative administration of pethidine in
17 laparoscopic gastric bypass ($P>0.05$).

18 **Conclusion:** Based on results of this study, administration of low dose lidocaine (1 mg/kg/h)
19 can be considered as an appropriate dose of IV lidocaine infusion in order to control
20 postoperative pain and nausea and vomiting in laparoscopic gastric bypass surgery.

21 **Keywords:** lidocaine, pain, nausea-vomiting, gastric bypass

22 **1. Introduction**

23 In post-operative time, it is important to control and reduce postoperative pain and nausea-
24 vomiting (1). Different drugs and methods are used to relieve postoperative pain and nausea
25 and vomiting in different surgeries (2). One of these methods, which has been studied on
26 numerous occasions, is intraoperative intravenous (IV) lidocaine infusion undergone in a
27 wide range of surgical procedures such as laparotomy, laparoscopy, gynecological surgery,
28 orthopedics, etc., and has a positive effect in most cases in reducing postoperative pain and
29 nausea-vomiting (3). Considering the pharmacological effects of IV lidocaine, which has
30 both anti-inflammatory and analgesic effects (protein receptor inhibitor G and NMDA),
31 lidocaine has been used to relieve postoperative pain (4). According to numerous studies on
32 various surgical procedures, intraoperative IV lidocaine infusion has been shown to reduce
33 postoperative pain and nausea and vomiting (5-14). Although the exact same dosage is still
34 unknown, the conducted studies have used 1-2 mg/kg/h dosages. In a double-blind clinical
35 trial on 41 patients undergoing microdiscectomy in two groups receiving 1.5 mg/kg/h lidocaine
36 infusion and normal saline infusion as placebo, Kim et al (2014) concluded that fentanyl

37 administration and postoperative pain intensity were significantly lower in the lidocaine
38 group except 48 hours after surgery. Total fentanyl administration, hospital stay and
39 satisfaction were significantly lower in lidocaine group than placebo group. Finally,
40 intraoperative systemic infusion of lidocaine reduces pain level during **microdiscectomy**
41 surgery (6). According to the studies, this study tends to evaluate and compare the effect of
42 intraoperative 1 mg/kg/h and 2 mg/kg/h IV lidocaine infusion on postoperative pain and
43 nausea-vomiting in laparoscopic gastric bypass to determine a more suitable and effective
44 dosage.

45 **2. Materials and Methods**

46 This study was a randomized clinical trial. The studied population included elective patients
47 who were candidate for laparoscopic gastric bypass referred to Rasoul-e-Akram Hospital
48 since June 2014 to March 2015. Sampling method was convenient sampling. Sample size was
49 determined using Cohen table with 80% statistical power, 0.05 alpha and 0.9 accuracy (21
50 subjects in each group). This study was a randomized clinical trial. Block randomization was
51 done in quadrilateral blocks. This study was performed on 42 elective patients who were
52 candidate for laparoscopic gastric bypass referred to Rasoul-e-Akram Hospital since June
53 2014 to March 2015. After obtaining consent and qualifying patients for inclusion and
54 exclusion, 41 patients were assigned into 2 groups of 21 patients (A and B) in 4 blocks. After
55 entering the operating room, standardized monitoring (ECG-POM-NIBP-Etc₂) and insertion
56 of two 20G IV catheters and 3 cc/kg crystalloid serum infusion were performed for all
57 patients. Then, 3 mcg/kg fentanyl based on TBW and 20 mcg/kg midazolam based on TBW
58 were administered as premedication for all patients. For induction, all patients received 5
59 mg/kg thiopental sodium based on TBW followed by 0.2 mg/kg atracurium based on IBW
60 and 1.5 mcg/kg bolus lidocaine based on IBW for general anesthesia. After intubation of the
61 patients, all of them received 1.2 mac isoflurane followed by 0.03 mg/kg atracurium every 30
62 minutes and 50 mcg fentanyl every 40 minutes as maintenance. From the beginning of
63 surgery, group A received 1 mg/kg/h IV lidocaine infusion and group B received 2 mg/kg/h
64 IV lidocaine infusion by the pump until the end of surgery for a maximum of 4 hours. After
65 the end of surgery and discontinuation of all drugs, patients were placed in reserve by 0.04
66 mg/kg nisosigine and 0.02 mg/kg atropine and extubation was done; patients were transferred
67 to PACU (recovery). The time to enter recovery was set at t=0; for 24 h, patients were
68 monitored for pain based on numerical rating score (0-10), static and dynamic nausea-

69 vomiting, blood pressure (BP), heart rate and agitation in predicted times in the recovery or
70 surgery wards.

71 Finally, data was analyzed by SPSS software version 22. In the analytical step, Kolmogorov-
72 Sminov test was used for determining normality of quantitative values. Then, independent T-
73 test or Mann-Whitney U-test were used for comparing the quantitative variables of two
74 groups A and B. Chi-square test (Z) was used to compare the qualitative variables. Repeated
75 measure ANOVA or Friedman test was used to check and compare the changes.

76 3. Results

77 In this study, 42 patients who were referred to surgery ward of the Rasoul-e-Akram Hospital
78 in 2016 and underwent laparoscopic elective gastric bypass were enrolled in the study. In
79 group A, 21 patients (50%) received intraoperative 1 mg/kg/h IV lidocaine infusion; in group
80 B, 21 patients (50%) received intraoperative 2 mg/kg/h IV lidocaine infusion.

81 The patients aged 18-49 years (36.15 ± 6.88); 18 patients (42.9%) were male and 24 patients
82 (57.1%) were female. BMI was 38-46 Kg/m² (42.23 ± 2.22 Kg/m²). Ten patients (23.8%)
83 were in Class ASA 1, 25 patients (59.5%) were in Class ASA 2 and 7 patients (16.7%) were
84 in Class ASA 3.

85 According to the patients, 16 people (38.1%) had a history of hypertension. None of the
86 patients had a history of heart disease. Four patients (9.5%) had a history of diabetes, 9
87 patients (21.4%) had a history of fatty liver disease, and 8 (19%) had a history of other
88 diseases.

89 In terms of the history of previous drugs, 5 patients (11.9%) took cigarette, 4 patients (9.5%)
90 took loratadine, 3 (7.1%) took metoral, 4 (9.5%) took metformin, 2 (4.8%) took
91 levothyroxine, 1 (2.4%) took loratadine and levothyroxine, 4 (9.5%) took loratadine and
92 metformin, 1 (2.4%) took atenolol and levothyroxine, 2 (4.8%) took metformin and
93 glibenclamide, 2 (4.8%) took metformin and metoral, and 1 (2.4%) took loratadine and
94 metformin and hydroxin. Descriptive characteristics and comparison of age and gender of
95 patients undergoing elective laparoscopic gastric bypass in two groups A and B are
96 summarized in Table 1.

97 **Table 1: Descriptive characteristics and comparison of age and gender of patients undergoing elective laparoscopic**
98 **gastric bypass in two groups A and B**

Characteristic	Group		P-Value
	A	B	
Age (year) Mean \pm SD	34.48 \pm 5.34	37.9 \pm 7.96	0.11
Gender			1

Male	9 (42.9%)	9 (42.9%)
Female	12 (57.1%)	12 (57.1%)

99 According to Table 1, there is no significant difference in age and gender of patients
 100 undergoing elective laparoscopic gastric bypass between two groups A and B ($P>0.05$).

101 **3.1. Determining and Comparing Pain in Two Groups A and B Based on Numerical Rating**
 102 **Score at Times 0, 30 min, 1 h, 6 h, 12 h and 24 h after Laparoscopic Gastric Bypass**

103 In order to compare the pain level in 2 groups A and B based on numerical rating score at
 104 times 0, 30 min, 1 h, 6 h, 12 h, and 24 h after laparoscopic gastric bypass, the Mann-Whitney
 105 U-test was used. Friedman test was used for comparison at times 0, 30 min, 1 h, 6 h, 12 h and
 106 24 h after laparoscopic gastric bypass in each of the two groups A and B (separately).
 107 Descriptive features and comparison of pain levels are summarized in Table 2.

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109 **Table 2: descriptive features and comparison of pain level in two groups A and B based on numerical rating score at**
 110 **times 0, 30 min, 1 h, 6 h, 12 h and 24 h after laparoscopic gastric bypass**

Time	Group		Test statistic	p-value
	A (mean ± SD)	B (mean ± SD)		
0	1.67 ± 1.01	1.71 ± 0.78	0.014	0.989
30 min	2.67 ± 0.73	2.67 ± 0.65	0.139	0.889
1 h	3.29 ± 0.84	3.19 ± 0.98	0.346	0.729
6 h	5.71 ± 0.9	5.57 ± 1.2	0.898	0.369
12 h	4.86 ± 0.96	4.71 ± 0.95	0.404	0.687
24 h	3.95 ± 1.39	3.81 ± 1.03	0.199	0.842
-	$P<0.001, X^2=94.18$	$P<0.001, X^2=88.29$	-	-

111 Based on the results of Table 2, there was no significant difference between pain levels of
 112 patients in 2 groups A and B based on numerical rating score at times 0, 30 min, 1 h, 6 h, 12
 113 h, and 24 h after laparoscopic gastric bypass ($P>0.05$). There was a significant difference
 114 between pain levels of patients based on numerical rating score at times 0, 30 min, 1 h, 6 h,
 115 12 h, and 24 h after laparoscopic gastric bypass in group A ($P<0.001, X^2=94.18$). There was a
 116 significant difference between pain levels of patients based on numerical rating score at times
 117 0, 30 min, 1 h, 6 h, 12 h, and 24 h after laparoscopic gastric bypass in group B ($P<0.001,$
 118 $X^2=88.29$).

119 **3.2. Determining and Comparing Static Nausea-Vomiting in Two Groups A and B at Times 0,**
 120 **30 min, 1 h, 6 h, 12 h and 24 h after Laparoscopic Gastric Bypass**

121 In order to compare static nausea-vomiting levels in 2 groups A and B after laparoscopic
 122 gastric bypass, Z-test was used. Friedman test was used for comparison at times 0, 30 min, 1
 123 h, 6 h, 12 h and 24 h after laparoscopic gastric bypass in each of the two groups A and B
 124 (separately). Frequency values and nausea-vomiting comparison are summarized in Table 3.

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Table 3: descriptive features and comparison of static nausea-vomiting levels in two groups A and B after laparoscopic gastric bypass

Time	Group		Test statistic	p-value
	A (N, %)	B (N, %)		
0	2 (9.5%)	5 (23.8%)	1.26	0.896
30 min	4 (19%)	3 (14.3%)	0.4	0.655
1 h	0 (0%)	1 (4.8%)	0.22	0.587
6 h	0 (0%)	0 (0%)	0	0.5
12 h	0 (0%)	0 (0%)	0	0.5
24 h	0 (0%)	0 (0%)	0	0.5
-	P=0.01, X ² =15	P=0.008, X ² =15.73	-	-

127 Based on the results of Table 3, there was no significant difference between static nausea-
 128 vomiting levels of patients in 2 groups A and B at times 0, 30 min, 1 h, 6 h, 12 h, and 24 h
 129 after laparoscopic gastric bypass (P>0.05). There was a significant difference between static
 130 nausea-vomiting levels of patients at times 0, 30 min, 1 h, 6 h, 12 h, and 24 h after
 131 laparoscopic gastric bypass in group A (P=0.01, X²=15). There was a significant difference
 132 between static nausea-vomiting levels of patients at times 0, 30 min, 1 h, 6 h, 12 h, and 24 h
 133 after laparoscopic gastric bypass in group B (P=0.008, X²=15.73).

134 **3.3. Determining and Comparing Dynamic Nausea-Vomiting in Two Groups A and B at Times**
 135 **0, 30 min, 1 h, 6 h, 12 h and 24 h after Laparoscopic Gastric Bypass**

136 In order to compare dynamic nausea-vomiting levels in 2 groups A and B after laparoscopic
 137 gastric bypass, Z-test was used. Friedman test was used for comparison at times 0, 30 min, 1
 138 h, 6 h, 12 h and 24 h after laparoscopic gastric bypass in each of the two groups A and B
 139 (separately). Frequency values and nausea-vomiting comparison are summarized in Table 4.

Table 4: descriptive features and comparison of dynamic nausea-vomiting levels in two groups A and B after laparoscopic gastric bypass

Time	Group		Test statistic	p-value
	A (N, %)	B (N, %)		
0	8 (38.1%)	6 (28.6%)	0.65	0.742
30 min	14 (66.7%)	11 (52.4%)	0.95	0.828
1 h	5 (23.8%)	5 (23.8%)	0	0.5
6 h	0 (0%)	0 (0%)	0	0.5
12 h	0 (0%)	0 (0%)	0	0.5
24 h	0 (0%)	0 (0%)	0	0.5
-	P=0.001, X ² =45	P=0.001, X ² =33.77	-	-

142 Based on the results of Table 4, there was no significant difference between dynamic nausea-
 143 vomiting levels of patients in 2 groups A and B at times 0, 30 min, 1 h, 6 h, 12 h, and 24 h
 144 after laparoscopic gastric bypass (P>0.05). There was a significant difference between
 145 dynamic nausea-vomiting levels of patients at times 0, 30 min, 1 h, 6 h, 12 h, and 24 h after
 146 laparoscopic gastric bypass in group A (P=0.001, X²=45). There was a significant difference

147 between dynamic nausea-vomiting levels of patients at times 0, 30 min, 1 h, 6 h, 12 h, and 24
 148 h after laparoscopic gastric bypass in group B ($P=0.001$, $X^2=33.77$).

149 **3.4. Determining and Comparing Agitation in Two Groups A and B at Times 0, 30 min and 1 h**
 150 **after Surgery**

151 In order to compare agitation levels in 2 groups A and B after laparoscopic gastric bypass, Z-
 152 test was used. Friedman test was used for comparison at times 0, 30 min and 1 h after surgery
 153 in each of the two groups A and B (separately). Frequency values and agitation comparison
 154 are summarized in Table 5.

155 **Table 5: descriptive features and comparison of agitation levels in two groups A and B after laparoscopic gastric**
 156 **bypass**

Time	Group		Test statistic	p-value
	A (N, %)	B (N, %)		
0	6 (28.6%)	5 (23.8%)	0.35	0.636
30 min	5 (23.8%)	6 (28.6%)	0.35	0.636
1 h	1 (4.8%)	1 (4.8%)	0	0.5
-	$P=0.072$, $X^2=5.25$	$P=0.097$, $X^2=4.66$	-	-

157 Based on the results of Table 5, there was no significant difference between agitation levels
 158 of patients in 2 groups A and B at times 0, 30 min and 1 h after laparoscopic gastric bypass
 159 ($P>0.05$). There was no significant difference between agitation levels of patients at times 0,
 160 30 min and 1 h after laparoscopic gastric bypass in group A ($P=0.072$, $X^2=5.25$). There was
 161 no significant difference between agitation levels of patients at times 0, 30 min and 1 h after
 162 laparoscopic gastric bypass in group B ($P=0.097$, $X^2=4.66$).

163 **3.5. Determining and Comparing Systolic BP in Two Groups A and B at Times 0, 30 min and 1**
 164 **h after Laparoscopic Gastric Bypass**

165 In order to compare systolic BP levels in 2 groups A and B at times 0, 30 min and 1 h after
 166 laparoscopic gastric bypass, independent t-test and Mann-Whitney U-test were used.
 167 Friedman test and repeated measure test were used for comparison of systolic BP levels at
 168 times 0, 30 min and 1 h after laparoscopic gastric bypass in each of the two groups A and B
 169 (separately). Descriptive features and comparison of systolic BP are summarized in Table 6.

170 **Table 6: descriptive features and comparison of systolic BP levels in two groups A and B at times 0, 30 min and 1 h**
 171 **after laparoscopic gastric bypass**

Time	Group		Test statistic	p-value
	A (mean \pm SD)	B (mean \pm SD)		
0	141.76 \pm 13.68	141.9 \pm 14.92	0.032	0.974
30 min	139.33 \pm 13.13	139.43 \pm 15.27	0.025	0.98
1 h	134.05 \pm 11.38	136.48 \pm 10.42	0.768	0.477
-	$P<0.001$, $X^2=27.71$	$P=0.012$, $X^2=5.59$	-	-

172 Based on the results of Table 6, there was no significant difference between systolic BP
 173 levels of patients in 2 groups A and B at times 0, 30 min and 1 h after laparoscopic gastric
 174 bypass ($P>0.05$). There was a significant difference between systolic BP levels of patients at
 175 times 0, 30 min and 1 h after laparoscopic gastric bypass in group A ($P<0.001$, $X^2=27.71$).
 176 There was a significant difference between systolic BP levels of patients at times 0, 30 min
 177 and 1 h after laparoscopic gastric bypass in group B ($P=0.012$, $X^2=5.59$).

178 **3.6. Determining and Comparing Diastolic BP in Two Groups A and B at Times 0, 30 min and 1**
 179 **h after Laparoscopic Gastric Bypass**

180 In order to compare diastolic BP levels in 2 groups A and B at times 0, 30 min and 1 h after
 181 laparoscopic gastric bypass, independent t-test was used. Repeated measure test was used for
 182 comparison of diastolic BP levels at times 0, 30 min and 1 h after laparoscopic gastric bypass
 183 in each of the two groups A and B (separately). Descriptive features and comparison of
 184 diastolic BP are summarized in Table 7.

185 **Table 7: descriptive features and comparison of diastolic BP levels in two groups A and B at times 0, 30 min and 1 h**
 186 **after laparoscopic gastric bypass**

Time	Group		Test statistic	p-value
	A (mean ± SD)	B (mean ± SD)		
0	91.24 ± 8.24	93.05 ± 9.71	0.651	0.519
30 min	89.57 ± 9.3	91.19 ± 11.27	0.508	0.615
1 h	86.24 ± 9.54	89.14 ± 7.35	1.18	0.245
-	$P<0.001$, $X^2=58.94$	$P=0.001$, $X^2=11.38$	-	-

187 Based on the results of Table 7, there was no significant difference between diastolic BP
 188 levels of patients in 2 groups A and B at times 0, 30 min and 1 h after laparoscopic gastric
 189 bypass ($P>0.05$). There was a significant difference between diastolic BP levels of patients at
 190 times 0, 30 min and 1 h after laparoscopic gastric bypass in group A ($P<0.001$, $X^2=58.94$).
 191 There was a significant difference between diastolic BP levels of patients at times 0, 30 min
 192 and 1 h after laparoscopic gastric bypass in group B ($P=0.001$, $X^2=11.38$).

193 **3.7. Determining and Comparing Heart Rate in Two Groups A and B at Times 0, 30 min and 1**
 194 **h after Laparoscopic Gastric Bypass**

195 In order to compare heart rate in 2 groups A and B at times 0, 30 min and 1 h after
 196 laparoscopic gastric bypass, independent t-test and Mann-Whitney test were used. Repeated
 197 measure test and Friedman test were used for comparison of heart rate at times 0, 30 min and
 198 1 h after laparoscopic gastric bypass in each of the two groups A and B (separately).
 199 Descriptive features and comparison of heart rate are summarized in Table 8.

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Table 8: descriptive features and comparison of heart rate in two groups A and B at times 0, 30 min and 1 h after laparoscopic gastric bypass

Time	Group		Test statistic	p-value
	A (mean ± SD)	B (mean ± SD)		
0	93.05 ± 7.32	96.86 ± 6.64	1.76	0.085
30 min	90.29 ± 6.66	92.86 ± 8.31	1.26	0.207
1 h	86.43 ± 6.47	88 ± 7.44	0.9	0.364
	P<0.001, X ² =28.5	P=0.001, X ² =67.43		

202 Based on the results of Table 8, there was no significant difference between heart rate of
203 patients in 2 groups A and B at times 0, 30 min and 1 h after laparoscopic gastric bypass
204 (P>0.05). There was a significant difference between heart rate of patients at times 0, 30 min
205 and 1 h after laparoscopic gastric bypass in group A (P<0.001, X²=28.5). There was a
206 significant difference between heart rate of patients at times 0, 30 min and 1 h after
207 laparoscopic gastric bypass in group B (P=0.001, X²=67.43).

208 3.8. Determining and Comparing the First, Second and Third Pethidine Administrations in Two 209 Groups A and B after Laparoscopic Gastric Bypass

210 In order to compare the first, second and third pethidine administrations in 2 groups A and B
211 after laparoscopic gastric bypass, Z-test was used. Frequency values and comparison of the
212 first, second and third pethidine administrations in groups A and B after laparoscopic gastric
213 bypass are summarized in Table 9.

214 **Table 9: descriptive features and comparison of the first, second and third pethidine administrations in two groups A
215 and B after laparoscopic gastric bypass**

Time	Group		Test statistic	p-value
	A (N, %)	B (N, %)		
1 st	6 (28.6%)	11 (52.3%)	1.61	0.053
2 nd	12 (57.1%)	8 (38%)	1.26	0.103
3 rd	3 (14.3%)	1 (4.8%)	1.06	0.144

216 Based on the results of Table 9, there was no significant difference between the first, second
217 and third pethidine administrations in 2 groups A and B after laparoscopic gastric bypass
218 (P>0.05).

219 4. Discussion

220 According to the most important results of this study, there was no significant difference
221 between the effect of intraoperative 1 mg/kg/h and 2 mg/kg/h IV lidocaine infusion on
222 postoperative pain, static and dynamic nausea-vomiting, agitation, systolic BP, diastolic BP,
223 heart rate and pethidine administration after laparoscopic gastric bypass. In both groups,
224 intraoperative 1 mg/kg/h and 2 mg/kg/h IV lidocaine infusion significantly increased pain 6

225 hours postoperatively and significantly decreased pain 24 hours postoperatively. Moreover,
226 postoperative static and dynamic nausea-vomiting, agitation, systolic BP, diastolic BP and
227 heart rate significantly decreased 0-24 hours after the surgery. Therefore, lidocaine seems to
228 reduce postoperative pain and complications. However, high-dose and low-dose lidocaine has
229 the same significant effect in reducing pain and complications after laparoscopic gastric
230 bypass.

231 Postoperative pain not only causes physical and mental torment, but also increases the risk of
232 side effects and delayed recovery. Therefore, it is important to eliminate emotional pain and
233 stress to maintain comfortable recovery, reduce the incidence of postoperative cardiovascular
234 complications and increase sooner discharge (15). It has been previously reported that
235 preoperative IV lidocaine infusion can increase postoperative analgesic effects and accelerate
236 early recovery; intraoperative continuous infusion can effectively prevent central hyperalgergy
237 through the pain pathway (16). Lidocaine has an insignificant opioid-sparing property in
238 patients undergoing various surgical procedures (17, 18). Several mechanisms have been
239 suggested to explain the insignificant opioid-sparing effect of preoperative lidocaine. First,
240 lidocaine has anti-inflammatory properties which can minimize the pain caused by surgical
241 inflammation (19, 20). Second, lidocaine also can directly block the pathways of pain
242 conducting sodium channels (21). Eventually, lidocaine can reduce the need for opioid drugs
243 or intraoperative volatile anesthetics, which may reduce the progression of postoperative pain
244 (22, 24).

245 Based on literature review, this study was the first study to compare the effects of two
246 different doses of lidocaine (1 mg/kg/h vs. 2 mg/kg/h IV infusion) on postoperative pain and
247 nausea-vomiting after laparoscopic gastric bypass. However, many studies have shown that
248 different doses of lidocaine infusion reduced postoperative pain level and side effects,
249 compared with placebo and other drugs. For example, Tikuišis et al (2014) studied 64
250 patients undergoing laparoscopic colon surgery and found that pain level significantly
251 decreased 24 h after the surgery in both rest and movement in 2 mg/kg/h lidocaine group
252 compared to placebo group. Moreover, there was no significant difference between
253 postoperative complications between the two groups (5). Through a meta-analysis, Ventham
254 et al. (2015) reviewed 40 clinical trials on comparing the effect of lidocaine infusion with
255 placebo or routine postoperative laparoscopic treatments and found that lidocaine
256 intervention reduced the pain score at rest in 2, 12 and 24 hours after surgery and reduced
257 nausea and vomiting (9). **Selcuk et al (2015)** studied 226 patients undergoing laparoscopic
258 gynecological surgery and revealed that 1% lidocaine infusion was more effective on

259 postoperative pain than placebo (12). Terkawi et al (2016) found no significant difference in
260 pain scores between the two groups by follow-up of 216 patients after 2 days of abdominal
261 surgery in two groups of 1 mg/kg/h IV Lidocaine infusion and epidural analgesia. In
262 lidocaine group, episodes of hypotension and postoperative nausea and vomiting were less
263 frequent than placebo group (14).

264 According to previous studies some of which has been noted in the previous paragraph, on a
265 certain dosage, pain and nausea-vomiting were not compared between two groups of 1
266 mg/kg/h and 2 mg/kg/h lidocaine; positive effect of lidocaine in reducing pain and nausea-
267 vomiting in most of these studies may be due to the fact that lidocaine has been compared
268 with opiate and placebo. Moreover, inconsistency of this study with some studies may be due
269 to differences in samples, design of studies, lidocaine doses and surgical site and procedures.

270 In the present study in which patients were carefully monitored for up to 24 hours after
271 surgery, although administration of high-dose lidocaine did not cause side effects after
272 surgery, administration of low doses, as high doses, reduced pain, nausea-vomiting and
273 agitation. Therefore, low doses of lidocaine (1 mg/kg/h), rather than high doses (2 mg/kg/h),
274 can be used as an appropriate dose of IV lidocaine infusion to control postoperative pain and
275 nausea-vomiting in laparoscopic gastric bypass.

276 **5. Conclusion**

277 Based on the results of this study, low doses of lidocaine (1 mg/kg/h), rather than high doses
278 (2 mg/kg/h), can be used as an appropriate dose of IV lidocaine infusion to control
279 postoperative pain and nausea-vomiting in laparoscopic gastric bypass.

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