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WisdomGale

RESEARCH ARTICLE

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Enhancing post-surgical pain relief: comparing lidocaine, bupivacaine, and their combination for Laparotomy by MGS (Mouse Grimace Scale)

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ABSTRACT

Pain management after surgery is crucial for improving the condition of patients in veterinary and human medicine. Analgesics are commonly administered via subcutaneous infiltration injection before the start of surgery. This study investigates post-anesthesia recovery and pain levels following subcutaneous injections of lidocaine and bupivacaine drugs, as well as their combination, after abdominal surgery. The study utilized lidocaine doses of 0.1 and 0.15 mg/kg^{-1}, bupivacaine doses of 1 and 2 mg/kg^{-1}, and a combination of 0.1 mg/kg^{-1} lidocaine and 1 mg/kg^{-1} bupivacaine. The study data was evaluated using the Rodent Face Finder software, a novel method for assessing pain during animal model recovery based on clinical changes. These changes include ratings in eye-opening (orbital changes), various ear angles (ear changes), whisker stance (whisker changes), and cheek angle (cheek changes). Videos were captured at 0, 2, 4, 8, 12, and 24 hours post-surgery, and analyzed using software and statistical evaluation. The results obtained 2 hours after surgery in the combined drug group (mixed drugs) showed a significant difference compared to all other groups ($p < 0.05$), while the remaining groups did not exhibit significant differences ($p > 0.05$), indicating indifference due to their effects. Pain levels before and after anesthesia can be justified. At 4–8 hours, the lidocaine and bupivacaine groups did not show significant differentiation from each other ($p > 0.05$), but the treatment groups differed significantly ($p < 0.05$). At 12 hours, the lidocaine groups and the 0.09% saline group showed significant differences ($p < 0.05$), while the remaining groups did not exhibit differences ($p > 0.05$). At 24 hours post-surgery, only the control group showed a significant difference from the other groups ($p < 0.05$). The study demonstrated that the specified doses of combined anesthetic drugs provided adequate analgesia in the initial hours after surgery, leading to proper recovery compared to other treatment groups. Additionally, varying rates of postoperative analgesia at 4–8 hours after surgery did not significantly impact the analgesia process. Anesthetic drugs can significantly affect the initial recovery process.

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Introduction

Effective pain management after surgical procedures is a vital consideration in evaluating and addressing pain during the recovery period, both in animal studies and in human clinical settings [1]. Several approaches are employed to assess pain in rodents, including behavioral assessments [2], which can be labor-intensive and necessitate specialized training and expertise [3]. Lidocaine, a widely used local anesthetic from the amide class, exhibits a half-life of approximately 1.5–2 hours in rats and is often administered before intravenous therapy in cancer patients. By blocking sodium channels, lidocaine provides both central and

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peripheral analgesic effects, encompassing both the central nervous system and visceral pain relief [4].

Bupivacaine, another local anesthetic, possesses a longer elimination half-life of 3.5–6 hours. Research has shown that preoperative infiltration of bupivacaine is an effective method for controlling pain in animals, providing prolonged analgesic benefits [5]. Furthermore, when combined with lidocaine, bupivacaine has been found to potentiate the analgesic effects of medications, allowing for enhanced pain relief without the need for increased dosing [6].

Multiple methods of pain assessment are utilized for both humans and animals, including the numerical rating scale (NRS) [7] and visual analog scale [8]. These scales generally operate on a 0-10 scale, with 0 indicating no pain and 10 representing the most severe pain [9].

The mouse grimace scale (MGS) is a pain assessment tool that evaluates the facial expressions of rodents during recovery, comprising five distinct facial conditions: orbital tightening, ear positioning, whisker movement, and nose bulging. Each condition is scored on a scale of 0 to 2, based on video recordings of the animal's reaction to potentially painful stimuli [10].

This study aimed to investigate the facial expressions of rats following abdominal laparotomy using the MGS and Rodent Face Finder (RFF) software, and to compare the effects of subcutaneous injections of lidocaine, bupivacaine, and their combination on pain scores 24 hours post-surgery.

Material and Methods

Animals

The study included 7–9 week-old male rats, weighing approximately 200–250 g, obtained from the Pasteur Institute of Iran. The rats were housed in groups of 1–7, with ad-lib access to food and water, and a temperature-controlled environment. The study was approved by a local animal care and use committee and was consistent with national guidelines.

Lidocaine %2

Lidocaine is a common local anesthetic drug that was used in two doses: 0.1 mg/kg (0.00125 ml/rat) and 0.15 mg/kg (0.001875 ml/rat). The lidocaine was prepared in distilled water to a total volume of 0.5 ml for injection.

Bupivacaine %0.5

Bupivacaine is a long-acting analgesic that was used in two doses: 1 mg/kg (0.05 ml/rat) and 2 mg/kg (0.1 ml/rat). The bupivacaine was prepared in distilled water to a total volume of 0.5 ml for injection.

Lidocaine-bupivacaine combination

A combination of lidocaine and bupivacaine was used to increase the analgesic action and duration of action. The combination was prepared in distilled water to a total volume of 0.5 ml for injection. The total volume for each injection was extended into 0.5 ml in the same dose to eliminate the factor of volume of injection in the study.

Laparotomy procedure

The laparotomy procedure was performed under general anesthesia with ketamine and xylazine.

The procedure involved a midline skin incision, followed by suturing of the muscles and skin.

Digital video recording and rodent face finder

The rats were placed in separate plexiglass cages and video recordings were made at 2, 4, 8, 12, and 24 hours after the surgical procedure. The video recordings were analyzed using the RFF software to determine pain indexes.

Rat grimace scale (RGS)

The RGS is a scale used to assess facial expressions in rodents. The scale consists of five facial expressions: orbital tightening, nose bulge, cheek bulge, ear position, and whisker change.

Accuracy

To ensure accuracy, the video recording conditions were set to be as silent as possible, with permanent light and without any factors that could affect the recovery period.

Statistical analyses

The Kolmogorov-Smirnov test and Shapiro-Wilk test were used to evaluate the normal or non-normal distribution of data. The Kruskal-Wallis analysis was performed to evaluate the differentiation between the groups and investigated factors.

Results

The study found that the pain levels in all groups did not follow a normal distribution, except for occasional instances (Table 1). Therefore, the pain

Table 1. Examining the normality of the distribution of pain levels.

	Experimental Group	Kolmogorov-Smirnov[h]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
H2	No treatment	0.277	8	0.070	0.748	8	0.008
	Salin normal 0.9%	0.316	8	0.018	0.772	8	0.014
	Lidocaine 0.1 mg/;g	0.322	8	0.014	0.738	8	0.006
	Lidocaine 0.15 mg/kg	0.223	8	0.200*	0.861	8	0.122
	Bopivacaine 1 mg/kg	0.252	8	0.144	0.827	8	0.055
	Bopivacaine 2 mg/kg	0.223	8	0.200*	0.861	8	0.122
H4	No treatment	0.301	8	0.031	0.782	8	0.018
	Salin normal 0.9%	0.250	8	0.150	0.849	8	0.093
	Lidocaine 0.1 mg/;g	0.340	8	0.007	0.689	8	0.002
	Lidocaine 0.15 mg/kg	0.301	8	0.031	0.782	8	0.018
	Bopivacaine 1mg/kg	0.455	8	0.000	0.566	8	0.000
	Bopivacaine 2 mg/kg	0.393	8	0.001	0.719	8	0.004
H8	No treatment	0.250	8	0.150	0.849	8	0.093
	Salin normal 0.9%	0.301	8	0.031	0.782	8	0.018
	Lidocaine 0.1mg/;g	0.282	8	0.061	0.832	8	0.062
	Lidocaine 0.15 mg/kg	0.325	8	0.013	0.665	8	0.001
	Bopivacaine 2 mg/kg	0.250	8	0.150	0.849	8	0.093
	Mixed	0.325	8	0.013	0.665	8	0.001
H12	No treatment	0.277	8	0.070	0.748	8	0.008
	Salin normal 0.9%	0.325	8	0.013	0.665	8	0.001
	Lidocaine 0.1 mg/;g	0.325	8	0.013	0.665	8	0.001
	Bopivacaine 1 mg/kg	0.250	8	0.150	0.849	8	0.093
	Bopivacaine 2 mg/kg	0.325	8	0.013	0.665	8	0.001
	Mixed	0.455	8	0.000	0.566	8	0.000
H24	No treatment	0.277	8	0.070	0.748	8	0.008
	Lidocaine 0.1 mg/;g	0.455	8	0.000	0.566	8	0.000

Table 2. Comparison of median and interquartile range of pain level in different treatment groups.

Experimentalgroup														*P* =
1		2		3		4		5		6		7		
Median	25–75 P	Median	25–75 P	Median	25–75 P	Median	25–75 P	Median	25–75 P	Median	25–75 P	Median	25–75 P	
0.000	0.000–0.000	0.000	0.000–0.000	0.000	0.000–0.000	0.000	0.000–0.000	0.000	0.000–0.000	0.000	0.000–0.000	0.000	0.000–0.000	1
3.500	3	4.000	3	4.000	5	2.000	4	4.500	5	3.000	4	3.000	-	0.353
3.500	2	3.000	2	3.500	4	1.500	5	2.000	1	2.000	1.500–4.000	2.000	-	0.008
2.000	2	1.500	2	2.500	6	0.500	1	1.000	-	1.000	2	1.500	1	0.006
0.500	3	0.500	1	2.000	2	0	0	1.000	2	0.500	1	1	1	0.002
0.500	3	0	0	0.000	1	0	0	0	0	0	0	0	0	0.004

Table 3. Comparison of individual changes against other group members multiple comparisons at 8 hours after the study with Bonferroni test (lidocaine 0.1 mg.kg^{-1} with 0.15 mg.kg^{-1} and bupivacaine had significant differences.

(I) Experimental group	(J) Experimental group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence interval	
					Lower bound	Upper bound
No treatment	Salin normal 0.9%	0.750	0.666	1.000	–1.38	2.88
	Lidocaine 0.1 mg/;g	–1.250	0.666	1.000	–3.38	0.88
	Lidocaine 0.15 mg/kg	1.500	0.666	0.606	–0.63	3.63
	Bopivacaine 1 mg/kg	1.000	0.666	1.000	–1.13	3.13
	Bopivacaine 2 mg/kg	1.000	0.666	1.000	–1.13	3.13
	Mixed	0.500	0.666	1.000	–1.63	2.63
Salin normal 0.9%	No treatment	–0.750	0.666	1.000	–2.88	1.38
	Lidocaine 0.1 mg/;g	–2.000	0.666	0.088	–4.13	0.13
	Lidocaine 0.15 mg/kg	0.750	0.666	1.000	–1.38	2.88
	Bopivacaine 1 mg/kg	0.250	0.666	1.000	–1.88	2.38
	Bopivacaine 2 mg/kg	0.250	0.666	1.000	–1.88	2.38
	Mixed	–0.250	0.666	1.000	–2.38	1.88
Lidocaine 0.1 mg/;g	No treatment	1.250	0.666	1.000	–0.88	3.38
	Salin normal 0.9%	2.000	0.666	0.088	–0.13	4.13
	Lidocaine 0.15 mg/kg	2.750*	0.666	0.003	0.62	4.88
	Bopivacaine 1 mg/kg	2.250*	0.666	0.030	0.12	4.38
	Bopivacaine 2 mg/kg	2.250*	0.666	0.030	0.12	4.38
	Mixed	1.750	0.666	0.241	–0.38	3.88
Lidocaine 0.15 mg/kg	No treatment	–1.500	0.666	0.606	–3.63	0.63
	Salin normal 0.9%	–0.750	0.666	1.000	–2.88	1.38
	Lidocaine 0.1 mg/;g	–2.750*	0.666	0.003	–4.88	–0.62
	Bopivacaine 1 mg/kg	–0.500	0.666	1.000	–2.63	1.63
	Bopivacaine 2 mg/kg	–0.500	0.666	1.000	–2.63	1.63
	Mixed	–1.000	0.666	1.000	–3.13	1.13
Bopivacaine 1mg/kg	No treatment	–1.000	0.666	1.000	–3.13	1.13
	Salin normal 0.9%	–0.250	0.666	1.000	–2.38	1.88
	Lidocaine 0.1 mg/;g	–2.250*	0.666	0.030	–4.38	–0.12
	Lidocaine 0.15 mg/kg	0.500	0.666	1.000	–1.63	2.63
	Bopivacaine 2 mg/kg	0.000	0.666	1.000	–2.13	2.13
	Mixed	-0.500	0.666	1.000	–2.63	1.63
Bopivacaine 2 mg/kg	No treatment	–1.000	0.666	1.000	–3.13	1.13
	Salin normal 0.9%	–0.250	0.666	1.000	–2.38	1.88
	Lidocaine 0.1 mg/;g	–2.250*	0.666	0.030	–4.38	–0.12
	Lidocaine 0.15 mg/kg	0.500	0.666	1.000	–1.63	2.63
	Bopivacaine 1 mg/kg	0.000	0.666	1.000	–2.13	2.13
	Mixed	–0.500	0.666	1.000	–2.63	1.63
Mixed	No treatment	–0.500	0.666	1.000	–2.63	1.63
	Salin normal 0.9%	0.250	0.666	1.000	–1.88	2.38
	Lidocaine 0.1 mg/;g	–1.750	0.666	0.241	–3.88	0.38
	Lidocaine 0.15 mg/kg	1.000	.666	1.000	–1.13	3.13
	Bopivacaine 1 mg/kg	0.500	0.666	1.000	–1.63	2.63
	Bopivacaine 2 mg/kg	0.500	0.666	1.000	–1.63	2.63

*. The mean difference is significant at the 0.05 level.

levels in the study groups were considered to have a non-normal distribution. A comparison of the median and interquartile range of pain levels among different treatment groups is presented in Table 2. Friedman's test revealed a significant difference in the trend of changes in pain levels over time among the groups (p = 0.0001). The Kruskal-Wallis analysis showed that there were no significant differences among the treatment groups before the start of the study and 2 hours after. However, significant

Table 4. Comparison of individual changes against other group members multiple comparisons at 12 hours after the study with the Bonferroni test (lidocaine 0.1 mg.kg^{-1} had a significant difference with 0.15 mg.kg^{-1} and Saline serum).

(I) Experimental group	(J) Experimental group	Mean difference (I-J)	Std. error	Sig.	95% Confidence interval	
					Lower bound	Upper bound
No treatment	Salin normal 0.9%	0.500	0.388	1.000	–0.74	1.74
	Lidocaine 0.1 mg/;g	–1.000	0.388	0.273	–2.24	0.24
	Lidocaine 0.15 mg/kg	1.000	0.388	0.273	–0.24	2.24
	Bopivacaine 1 mg/kg	0.000	0.388	1.000	–1.24	1.24
	Bopivacaine 2 mg/kg	0.500	0.388	1.000	–0.74	1.74
	Mixed	0.250	0.388	1.000	–0.99	1.49
Salin normal 0.9%	No treatment	–0.500	0.388	1.000	–1.74	0.74
	Lidocaine 0.1 mg/;g	–1.500*	0.388	.007	–2.74	–0.26
	Lidocaine 0.15 mg/kg	0.500	0.388	1.000	–0.74	1.74
	Bopivacaine 1 mg/kg	–0.500	0.388	1.000	–1.74	0.74
	Bopivacaine 2 mg/kg	0.000	0.388	1.000	–1.24	1.24
	Mixed	–0.250	0.388	1.000	–1.49	0.99
Lidocaine 0.1mg/;g	No treatment	1.000	0.388	0.273	–0.24	2.24
	Salin normal 0.9%	1.500*	0.388	0.007	0.26	2.74
	Lidocaine 0.15 mg/kg	2.000*	0.388	0.000	0.76	3.24
	Bopivacaine 1 mg/kg	1.000	0.388	0.273	–0.24	2.24
	Bopivacaine 2 mg/kg	1.500*	0.388	0.007	0.26	2.74
	Mixed	1.250*	0.388	0.048	0.01	2.49
Lidocaine 0.15 mg/kg	No treatment	–1.000	0.388	0.273	–2.24	0.24
	Salin normal 0.9%	–0.500	0.388	1.000	–1.74	0.74
	Lidocaine 0.1 mg/;g	–2.000*	0.388	0.000	–3.24	–0.76
	Bopivacaine 1 mg/kg	–1.000	0.388	0.273	–2.24	0.24
	Bopivacaine 2 mg/kg	–0.500	0.388	1.000	–1.74	0.74
	Mixed	–0.750	0.388	1.000	–1.99	0.49
Bopivacaine 1mg/kg	No treatment	0.000	0.388	1.000	–1.24	1.24
	Salin normal 0.9%	0.500	0.388	1.000	–0.74	1.74
	Lidocaine 0.1 mg/;g	–1.000	0.388	.273	–2.24	0.24
	Lidocaine 0.15 mg/kg	1.000	0.388	.273	–.24	2.24
	Bopivacaine 2 mg/kg	0.500	0.388	1.000	–.74	1.74
	Mixed	0.250	0.388	1.000	–.99	1.49
Bopivacaine 2 mg/kg	No treatment	–0.500	0.388	1.000	–1.74	0.74
	Salin normal 0.9%	0.000	0.388	1.000	–1.24	1.24
	Lidocaine 0.1 mg/;g	–1.500*	0.388	0.007	–2.74	–.26
	Lidocaine 0.15 mg/kg	0.500	0.388	1.000	–.74	1.74
	Bopivacaine 1 mg/kg	–0.500	0.388	1.000	–1.74	0.74
	Mixed	–0.250	0.388	1.000	–1.49	0.99
Mixed	No treatment	–0.250	0.388	1.000	–1.49	0.99
	Salin normal 0.9%	0.250	0.388	1.000	–0.99	1.49
	Lidocaine 0.1 mg/;g	–1.250*	0.388	0.048	–2.49	–0.01
	Lidocaine 0.15 mg/kg	0.750	0.388	1.000	–0.49	1.99
	Bopivacaine 1 mg/kg	–0.250	0.388	1.000	–1.49	0.99
	Bopivacaine 2 mg/kg	0.250	0.388	1.000	–0.99	1.49

*. The mean difference is significant at the 0.05 level.

differences were found between the groups at 4, 8, 12, and 24 hours after the study (Table 3). The data revealed no significant changes in pain levels at 0 and 2 hours after the start of the study among the different groups ($p > 0.05$). However, significant differences were found in pain levels at 4, 8, 12, and 24 hours after the study among the treatment groups ($p < 0.05$). The Bonferroni test was used to compare individual changes against other group members at 8 hours after the study. The results

showed a significant difference between lidocaine 0.1 mg/kg^{-1} and lidocaine 0.15 mg/kg^{-1}, as well as bupivacaine (Table 3). This means that there was no difference between treatment groups and saline 0.09% until 8 hours post-procedure. Similarly, when comparing individual changes against other group members at 12 hours after the study using the Bonferroni test, the lidocaine 0.1 mg/kg^{-1} group showed a significant difference compared to lidocaine 0.15 mg/kg^{-1} and saline serum. However, the

Table 5. Comparison of individual changes against other group members Multiple Comparisons at 24 hours after the study with Bonferroni test (only group 0 showed differences with others and the others did not).

(I) Experimental group	(J) Experimental group	Mean difference (I-J)	Std. error	Sig.	95% Confidence interval	
					Lower bound	Upper bound
No treatment	Salin normal 0.9%	1.000*	0.262	0.008	0.16	1.84
	Lidocaine 0.1 mg/;g	0.750	0.262	0.131	-0.09	1.59
	Lidocaine 0.15 mg/kg	1.000*	0.262	0.008	0.16	1.84
	Bopivacaine 1 mg/kg	1.000*	0.262	0.008	0.16	1.84
	Bopivacaine 2 mg/kg	1.000*	0.262	0.008	0.16	1.84
	Mixed	1.000*	0.262	0.008	0.16	1.84
Salin normal 0.9%	No treatment	–1.000*	0.262	0.008	–1.84	–0.16
	Lidocaine 0.1 mg/;g	–0.250	0.262	1.000	–1.09	0.59
	Lidocaine 0.15 mg/kg	0.000	0.262	1.000	–0.84	0.84
	Bopivacaine 1 mg/kg	0.000	0.262	1.000	–0.84	0.84
	Bopivacaine 2 mg/kg	0.000	0.262	1.000	–0.84	0.84
	Mixed	0.000	0.262	1.000	–0.84	0.84
Lidocaine 0.1mg/;g	No treatment	–0.750	0.262	0.131	–1.59	0.09
	Salin normal 0.9%	0.250	0.262	1.000	–0.59	1.09
	Lidocaine 0.15 mg/kg	0.250	0.262	1.000	–0.59	1.09
	Bopivacaine 1 mg/kg	0.250	0.262	1.000	–0.59	1.09
	Bopivacaine 2 mg/kg	0.250	0.262	1.000	–0.59	1.09
	Mixed	0.250	0.262	1.000	–0.59	1.09
Lidocaine 0.15 mg/kg	No treatment	–1.000*	0.262	0.008	–1.84	–0.16
	Salin normal 0.9%	0.000	0.262	1.000	–0.84	0.84
	Lidocaine 0.1 mg/;g	–0.250	0.262	1.000	–1.09	0.59
	Bopivacaine 1 mg/kg	0.000	0.262	1.000	–0.84	0.84
	Bopivacaine 2 mg/kg	0.000	0.262	1.000	–0.84	0.84
	Mixed	0.000	0.262	1.000	–0.84	0.84
Bopivacaine 1mg/kg	No treatment	–1.000*	0.262	0.008	–1.84	–0.16
	Salin normal 0.9%	0.000	0.262	1.000	–0.84	0.84
	Lidocaine 0.1 mg/;g	–0.250	0.262	1.000	–1.09	0.59
	Lidocaine 0.15 mg/kg	0.000	0.262	1.000	–0.84	0.84
	Bopivacaine 2 mg/kg	0.000	0.262	1.000	–0.84	0.84
	Mixed	0.000	0.262	1.000	–0.84	0.84
Bopivacaine 2 mg/kg	No treatment	–1.000*	0.262	0.008	–1.84	–0.16
	Salin normal 0.9%	0.000	0.262	1.000	–0.84	0.84
	Lidocaine 0.1 mg/;g	–0.250	0.262	1.000	–1.09	0.59
	Lidocaine 0.15 mg/kg	0.000	0.262	1.000	–0.84	0.84
	Bopivacaine 1 mg/kg	0.000	0.262	1.000	–0.84	0.84
	Mixed	0.000	0.262	1.000	–0.84	0.84
Mixed	No treatment	–1.000*	0.262	0.008	–1.84	–0.16
	Salin normal 0.9%	0.000	0.262	1.000	–0.84	0.84
	Lidocaine 0.1 mg/;g	–0.250	0.262	1.000	–1.09	0.59
	Lidocaine 0.15 mg/kg	0.000	0.262	1.000	–0.84	0.84
	Bopivacaine 1 mg/kg	0.000	0.262	1.000	–0.84	0.84
	Bopivacaine 2 mg/kg	0.000	0.262	1.000	-0.84	0.84

*. The mean difference is significant at the 0.05 level.

group without treatment (saline 0.09%) did not show a significant difference compared to the bupivacaine group (Table 4).

Finally, when comparing each treatment group member at 24 hours after the study using the Bonferroni test, only the saline 0.09% group showed a significant difference compared to the other groups. The other treatment groups did not show a significant difference (Table 5).

Discussion

The study's findings reveal that within the initial 8 hours of the experiment, there was no significant disparity in overall exposure and facial pain among the treatment groups. This outcome may be attributed to the anesthetic and premedication sedative effects, which were achieved through Ketamine and Xylazine, respectively. The authors hypothesize that these effects may be less pronounced compared to inhalation anesthesia and may also influence the recovery period.

Local anesthetics exert their effects by stabilizing the membranes of peripheral nerves and influencing the proteins associated with these membranes in the skin and other tissues. Additionally, they can block pain-sensing nerve cells, known as nociceptors, and amplify inflammatory responses by modulating the production of prostaglandins and lysosomal enzymes [11]. In both animal and human studies, anesthetic agents have been shown to be the most effective means of alleviating surgical stress and discomfort, as demonstrated by various research studies [12,13]. Numerous studies have utilized preoperative analgesia and have found that bupivacaine exhibits analgesic effects lasting at least 24 hours, which exceeds the previously reported duration of 6-12 hours [14,15]. Our study suggests that the primary analgesic effects of bupivacaine begin to wane after 6 hours of the surgical procedure, potentially giving way to rebound-type pain. We chose to compare the long-term and short-term analgesic effects of bupivacaine, lidocaine, and their combination to assess their ability to minimize the risk of central sensitization that can occur when the surgical block is rapidly dissipated [5].

The available literature on *in vivo* incisional wound healing following incisional analgesia (preemptive, intraoperative, or post-operative) is limited, and some studies suggest that using bupivacaine alone may not provide any benefits and may even increase complications at the surgical site,

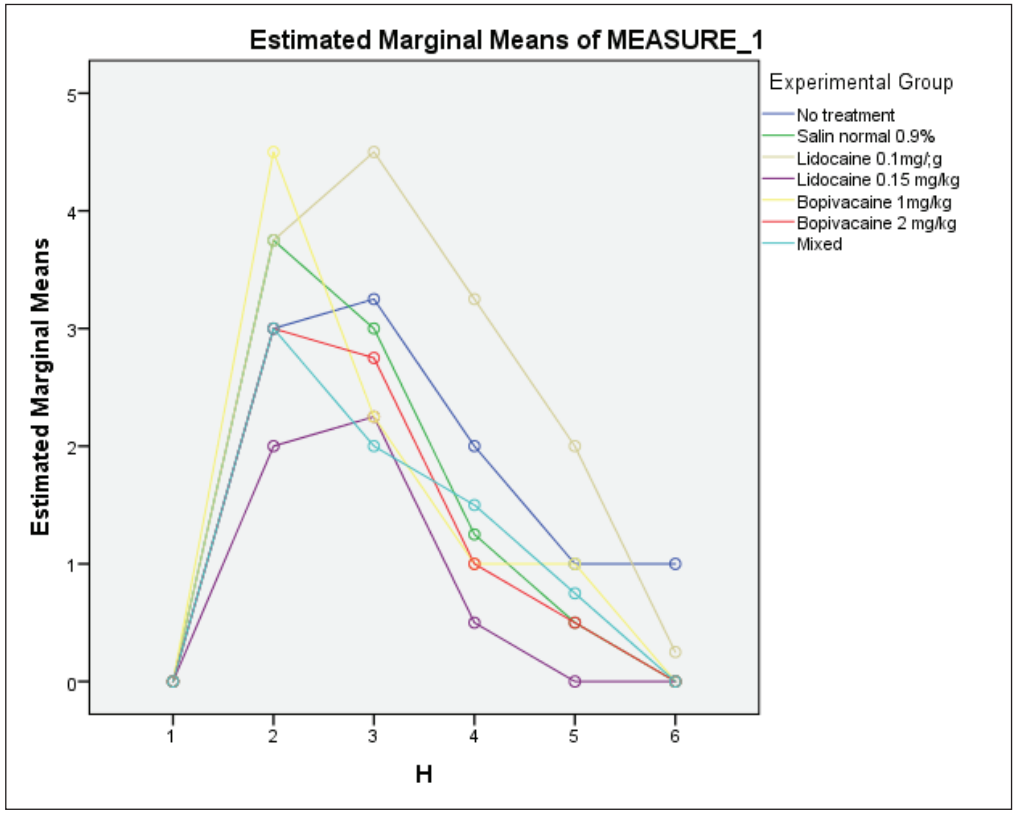

Figure 1. Comparing the pattern of changes in pain levels among different treatment groups at different times of the study.

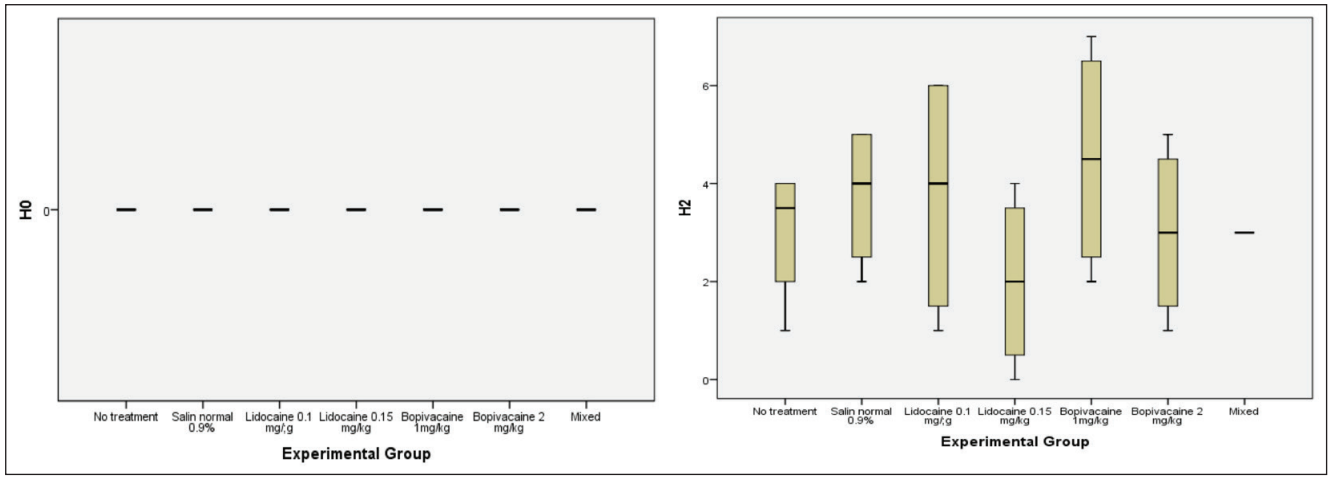

Figure 2. The degree of pain at 0 and 2 hours after the start of the study among the 7 different groups ($p > 0.05$).

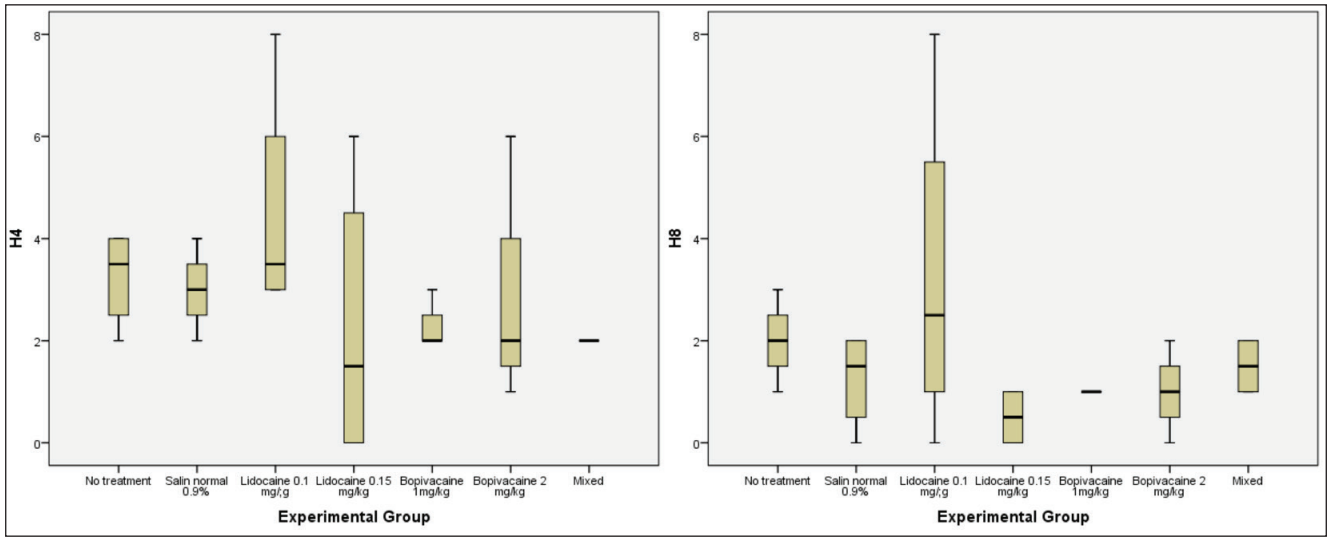

Figure 3. The degree of pain in 4 and 8 hours after the start of the study among the 7 different groups ($p < 0.05$).

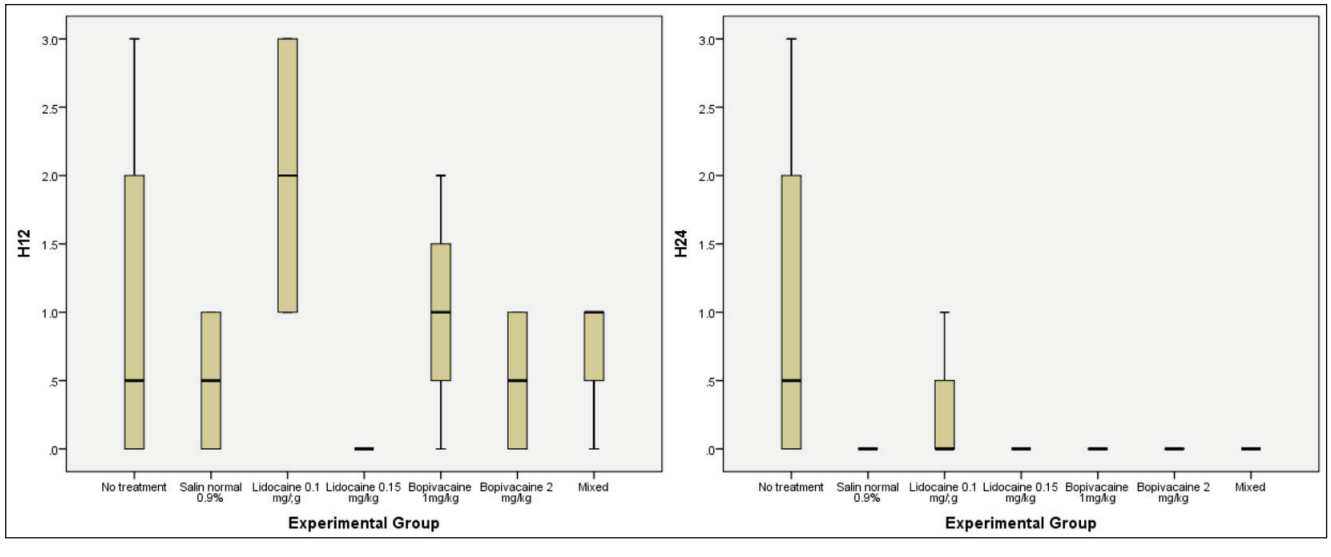

Figure 4. The degree of pain in 12 and 24 hours after the start of the study among the 7 different groups ($p < 0.05$)

such as delayed wound healing, hematoma, and herniation [16]. A similar study found no significant differences in outcomes when comparing lidocaine, bupivacaine, and their combination when applied intraoperatively [17]. Our survey analysis reveals that during the initial 12 hours after the procedure, there were no notable differences among the treatment groups. However, we observed better clinical recovery outcomes in the combination group after the first 6 hours following the procedure.

This study has some limitations. One limitation is that we only examined laparotomy procedures without any accompanying intra-abdominal procedures. Future research would benefit from comparing the different groups with surgical interventions following abdominal procedures. Additionally, our study only compared two doses of lidocaine and bupivacaine, as well as their combination, over a 24-hour period. Our survey focused on postoperative injections of lidocaine (0.1 and 0.15 mg/kg) and bupivacaine (1 and 2 mg/kg), as well as the combination of the lowest doses of these analgesics.

Conclusion

Our study found that the combination of lidocaine and bupivacaine in the lowest dose (0.1 and 1 mg/kg, respectively) provides gentle analgesia in the initial hours after surgery, with a more rapid recovery compared to other treatment groups. Furthermore, our results suggest that different doses of postoperative analgesia at fourth and eighth hours of surgery have no significant impact on the analgesia process. Additionally, we found that analgesics can have a substantial effect on the early recovery process.

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Conflict of interest

As stated above, the authors have no competing interests or conflicts of interest in this study.

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