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Original Research Article

Evaluation of lignocaine and dexmedetmdine infusion on recovery profile, quality of recovery and postoperative analgesia in patient undergoing total abdominal hysterectomy

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ABSTRACT

Background: Postoperative pain management aims to minimize side effects while achieving pain and discomfort reduction or elimination. The needs of each patient are taken into account when providing postoperative pain relief, which is contingent upon clinical, patient-related, and local factors. The patient's subjective assessment of pain is the ultimate determination of the extent to which pain is relieved. It has been demonstrated that using both systemic lignocaine and systemic dexmedetomidine together can effectively reduce postoperative pain and enhance the quality of recovery following surgery.
Aim & Objective: To evaluate and compare the quality of recovery score (QoR 40) with perioperative infusion of lignocaine and dexmedetomidine and analgesic requirement in postoperative period with the use of perioperative infusion of lignocaine or dexmedetomidine.
Materials and Methods: 135 female subjects posted for elective trans-abdominal hysterectomy under general anaesthesia were randomized to receive an infusion of Lignocaine (1.5 mg/kg over 15 minutes followed by a 2 mg/kg/h infusion until the end surgery) (Group 1) or Normal saline (10 ml over 15 minutes followed by infusion @1ml/kg/hr till the end of surgery) (Group 2) and inj. Dexmedetomidine (DEX) 1 mcg/kg over 15 minutes followed by infusion @0.6mcg/kg/hr till the end of surgery. (Group 3). Intraoperative hemodynamics, extubation variables, postoperative analgesic requirement, and quality of recovery score were evaluated.
Results: Lignocaine and dexmedetomidine infused intraoperatively preserved hemodynamics and met early extubation criteria. The duration of the first postoperative analgesic requirement as well as the total amount of analgesics needed in a 24-hour period were similar in groups 1 and 3, but significantly longer in the placebo "group 2. In Group 1, Group 2, & Group 3, the median (IQR) recovery score (QoR-40) was 184(178-191), 178(171-180), and 180(177-188). While there was no significant difference between the lignocaine and dexmedetomidine groups ($p>0.209$), it was significant" when compared to saline ($p<0.001$).
Conclusion: The application of intraoperative lignocaine/dexmedetomidine infusions was linked to early recovery, a lower need for postoperative analgesics, and a higher Quality of Recovery score, which indicated higher levels of patient satisfaction.

1. Introduction

The key to effective rehabilitation following surgery is managing postoperative pain efficiently. Opioids are commonly used to control pain after surgery, but

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numerous studies suggest that healthcare professionals often underestimate the effectiveness and duration of these medications. They may also be overly concerned about potential side effects such as sedation, respiratory depression, vomiting, and dependency, leading to undertreatment of acute pain.

For abdominal surgeries, epidural analgesia with a local anesthetic can be particularly beneficial. It enhances gastrointestinal function, reduces surgical stress, and provides excellent dynamic pain relief, which supports early mobilization. However, several randomized trials have questioned the benefits of epidural analgesia. The procedure for inserting an epidural catheter carries risks, is not always recommended, and may sometimes be declined by the patient.[1]

Hyperalgesia and central sensitization can develop as a result of an acute perioperative pain response, which may alter the anatomical and functional architecture of the pain pathways. Poorly managed pain during surgery increases the risk of chronic postsurgical pain. During the perioperative phase, multimodal analgesia encourages the use of multiple medications, which improves pain relief and reduces side effects associated with individual medications.[2]

Lidocaine offers a range of benefits, including anti-hyperalgesic, anti-inflammatory, and analgesic effects. It is believed to exert its analgesic effects by suppressing spontaneous impulses in the proximal dorsal root ganglion and damaged nerve fibers, primarily through the inhibition of G-protein coupled receptors, NMDA receptors, and sodium channels.[3] Similarly, $\alpha 2$ adrenoceptor agonists act at supraspinal, spinal, and peripheral sites, with dexmedetomidine use being associated with early postoperative nausea, reduced opioid consumption, and a moderate decrease in pain intensity.[4] Studies have shown that lidocaine and dexmedetomidine infusions can reduce the need for anesthesia and opioids during both the perioperative and postoperative phases of abdominal surgery.[5] Given these effects, we hypothesized that concurrent intravenous infusion of lidocaine or dexmedetomidine during surgery might influence postoperative pain and recovery.

2. Materials and Methods

This prospective randomized trial was conducted with written patient consent and institutional ethics approval (SRHU/HIMS/ETHICS/2014-94). The study involved 135 female patients, aged 30-65, scheduled for elective transabdominal hysterectomy under general anesthesia. All participants were classified as ASA I or II.

Exclusion criteria included patients with ASA grades III or IV, those over 65 years of age, individuals with a BMI greater than 35 kg/m^2, known allergies to local anesthetics, history of substance abuse, uncontrolled hypertension, A-V conduction block, sleep apnea, and those with a history of opioid, analgesic, psychotropic medication, or beta blocker use. Patients meeting the inclusion criteria were randomly assigned to one of three groups using computer-generated randomization to receive different interventions. Group 1: Received an injection of lidocaine 1.5 mg/kg over 15 minutes, followed by an infusion of lidocaine at 2 mg/kg/hr until the end of the surgery. Group 2: Received an injection of normal saline (10 ml over 15 minutes), followed by an infusion of normal saline at 1 ml/kg/hr until the end of the surgery. Group 3: Received an injection of dexmedetomidine 1 μg/kg over 15 minutes, followed by an infusion of dexmedetomidine at 0.6 μg/kg/hr until the end of the surgery.

Anesthesia induction was achieved using fentanyl 2 μg/kg and propofol 1–1.5 mg/kg until verbal commands were lost. Neuromuscular blockade was established with vecuronium 0.1 mg/kg. Endotracheal intubation was performed using a cuffed endotracheal tube (size 7–7.5). Anesthesia was maintained with 66% N_2O in O_2, incremental isoflurane concentrations, and intermittent boluses of fentanyl 1 μg/kg and vecuronium 1 mg. During the perioperative phase, bispectral index (BIS) values were maintained between 40 and 60, with adjustments to the isoflurane concentration as needed.

At the end of the procedure, the infusions were stopped. Neuromuscular blockade was reversed with glycopyrrolate 0.01 mg/kg and neostigmine 0.05 mg/kg, following thorough oral suction, return of spontaneous respiration, and a BIS value between 80 and 100. For postoperative analgesia, all patients received a 1 gm injection of paracetamol 15 minutes before extubation. Time was recorded for eye opening, response to verbal commands, and removal of the endotracheal tube following the administration of reversal agents.

Discharge from PACU was assessed by Aldrete score and the patient was shifted to the postoperative ward once the score reached $\geq$ 9. To manage intraoperative analgesia, a 100 mg injection of tramadol was administered, providing pain relief for up to eight hours. If the Visual Analog Scale (VAS) score exceeded 5, an additional 100 mg bolus of tramadol was given as rescue analgesia. The total tramadol dosage administered during the first 24 hours was recorded for each patient. Additionally, patients were monitored for the first passage of flatus, nausea, vomiting, and any other complications. On the fifth postoperative day, Quality of Recovery (QoR) was assessed using the QoR-40 scale, with a total score calculated for each patient to evaluate their recovery status.

Based on a prior study, the sample size required to detect a clinically significant difference of 10 points in the QoR-40 score with 80% power and a 0.05 significance level was calculated to be 42 patients per group. This calculation assumed a standard deviation based on previous data, and a two-tailed test was used to account for the possibility

of differences in either direction.To ensure robustness and account for potential dropouts or incomplete data, the sample size was increased. Thus, 45 patients were included in each group, providing an additional margin to maintain the study's power and reliability. Data analysis was conducted using SPSS IBM version 22 and Microsoft Office Excel 2007. Qualitative data were presented using frequencies and percentages or median and range, while quantitative data were summarized with means and standard deviations. The independent sample t-test was used to compare means of continuous variables. For data that were not normally distributed, non-parametric tests (Kruskal-Wallis) were employed, with a p-value of <0.05 considered statistically significant.

3. Results

The demographic profiles of the patients in each group are summarized in (Table 1). There were no significant differences among the groups regarding age, weight, and ASA grade ($p > 0.05$). (Table 2) presents the extubation rates across the groups, showing similar values for all three groups.

A comparison of the time interval to the first analgesic requirement, detailed in (Table 3), revealed that both Group 1 (lidocaine) and Group 3 (dexmedetomidine) experienced a significantly longer time before needing additional analgesics compared to the control group (Group 2), with a p-value of 0.002. When comparing the total tramadol dosages required, Group 2's dosage was significantly higher than that of Groups 1 and 3 ($p = 0.001$). The amount of tramadol needed in Groups 1 and 3 was similar, and the difference was not statistically significant ($p = 0.138$).

Table 4 shows that the QoR-40 scores in Groups 1 and 3 were significantly higher than those in Group 2. However, there was no significant difference in QoR-40 scores between Group 1 (lidocaine) and Group 3 (dexmedetomidine).

3.1. Haemodynamic variability

Hemodynamic parameters, which include heart rate (HR) as well as mean blood pressure, are displayed in (Figures 1 and 2). HR and mean arterial pressure (MAP) decreased in all groups from the baseline value; the greatest drop was seen with dexmedetomidine infusion; however, the group-to-group comparison showed that the decline was not statistically significant (p=0.059). All three groups experienced an increase in HR and MAP following intubation; however, Groups 1 and 2 showed the greatest changes in heart rate and MAP in comparison to Group 3. Even after five minutes of intubation, group 3's heart rate and MAP were lower than those of groups 1 and 2, but after that, they stabilized and were statistically comparable throughout the entire observation period (p>0.05). During the perioperative period, three patients in Group 3 (dexmedetomidine) experienced bradycardia (heart rate <45 beats/min), which required treatment with 0.6 mg of intravenous atropine.

Figure 3 presents a box plot illustrating the QoR-40 questionnaire scores on the fifth postoperative day following total abdominal hysterectomy. The box plot displays the median values as a solid line within the box, which is bounded by the 25th and 75th percentiles. This visualization highlights the distribution and central tendency of the QoR-40 scores across the different groups.

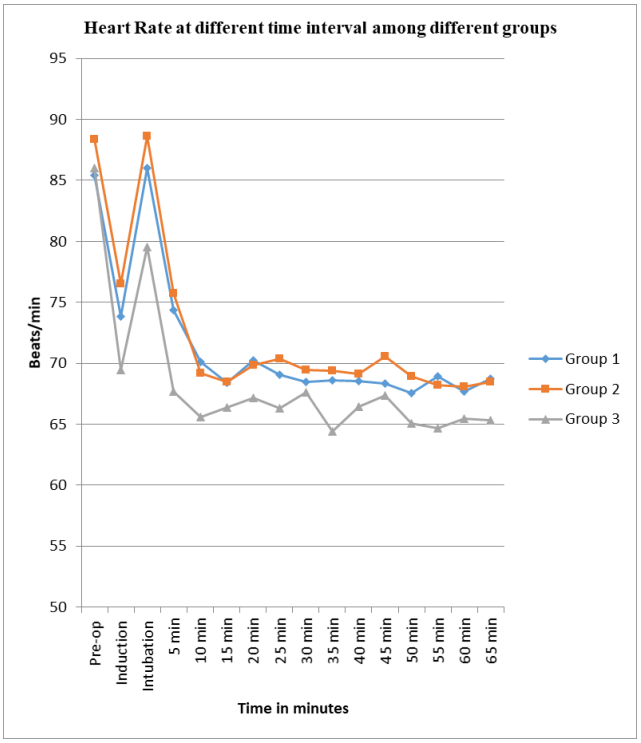

Figure 1: Heart rate at different time interval among different groups

4. Discussion

Reduced myocardial contractility, systemic vascular resistance, cardiac output, and systemic blood pressure are the hemodynamic effects of α-2 agonists. Hemodynamic response to an intravenous bolus of dexmedetomidine is biphasic. A rapid intravenous injection of 1 mcg/kg led to an initial increase in blood pressure and a decline in heart rate in relation to baseline. Dexmedetomidine stimulates peripheral α 2 receptors, which causes vasoconstrictive effects that likely account for the initial rise in blood pressure.[6,7] A decrease in HR as well as blood pressure occurs after this. However, lignocaine infusion is related to hemodynamic stability through effects on synaptic transmission, peripheral vasodilation, and direct myocardial

Table 1: Demographic profile

	Group 1	Group 2	Group 3	P value
No. of patients(n)	45	45	45	
ASA I/II	34/11	31/13	28/17	0.382*
Age in years (Mean±S.D.)	45.64±7.35	45.02±7.60	45.33±6.41	0.919**
Range of age (years)	35-60	30-65	34-60	
Weight in Kgs (Mean±S.D.)	61.75±9.93	57.97±6.94	58.08± 8.08	0.066**

Table 2: Recovery and extubation parameters

	Group 1	Group 2	Group 3	p value
T1 (mins) Mean±S.D.	2.77±2.04	2.75±1.76	2.68±1.48	0.178
T2 (mins) Mean±S.D.	3.56±2.68	4.51±3.40	3.4±3.31	0.200
T3 (mins) Mean±S.D.	3.38±2.42	4.57±3.34	3.73±3.24	0.395
T4 (mins) Mean±S.D.	10.20±3.15	11.11±3.38	11.45±4.25	0.142

T1- Time of extubation after afterreversal of neuromuscular blockade (T0),
T2- Time of eye opening after T0
T3- Time of verbal response after T0,
T4- Time to achieve alderate score ≥9 after T0

Table 3: Postoperative analgesic requirement

	Group 1 (n=45)	Group 2 (n=45)	Group 3 (n=45)	P value
Time for requirement of first analgesic (mins) Mean± S.D.	70.75±70.35	40.66±30.02	98.64±172.68	0.002
Total dosage(mg) Mean± S.D.	477.033±133.23	560.00±115.00	448.88±123.60	0.001

Table 4: Quality of recovery score

Parameters	Group 1 (n=45)	Group 2 (n=45)	Group 3 (n=45)	P value
QoR40 [median (IQR)]	184(178-191)	178(171-180)	180(177-188)	0.001

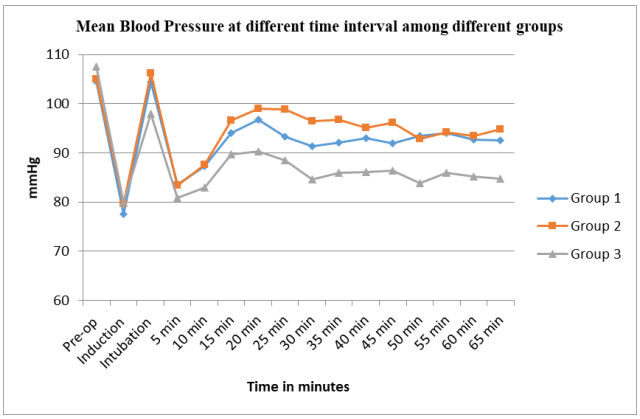

Figure 2: Mean blood pressure at different time interval among different groups

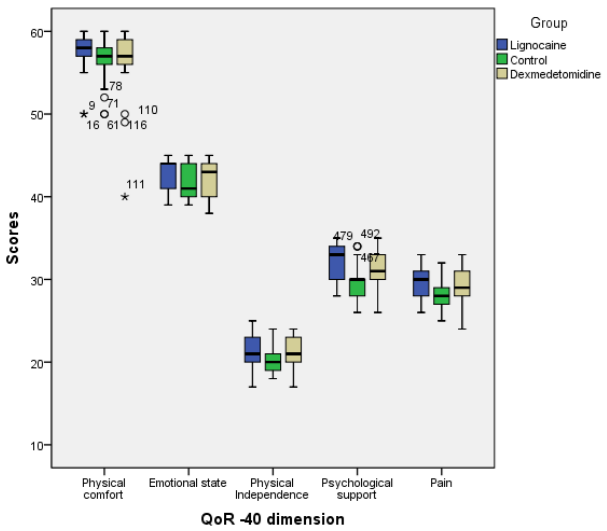

Figure 3: QoR- 40 dimension among different groups

depression.[8]

In our study, we discovered that after a fixed dosage of propofol was used to induce anesthesia, the infusion of either lignocaine or dexmedetomidine caused a drop in blood pressure from baseline. Hemodynamic parameters including HR, SBP, DBP, & MAP rise with intubation (Figures 1 and 2). The control group saw the biggest changes, while the dexmedetomidine infusion caused the least. After intubation, these effects typically lasted for up to five minutes before stabilizing. In contrast to lignocaine and placebo, the values in the dexmedetomidine group were, however, the lowest. Patel et al. in their investigation

found that dexmedetomidine infusion was associated with a decrease in SBP, DBP, MAP, and HR and less increase in these parameters from baseline compared to placebo.[9]

Tanskanen et al. demonstrated in their study that intraoperative infusion of dexmedetomidine at a rate of 0.4 μg/kg/hr effectively maintained blood pressure and heart rate within acceptable ranges.[10]

Similarly, Ali et al. investigated the use of intravenous lidocaine during laparoscopic cholecystectomy and found that, following intubation and pneumoperitoneum, both mean arterial pressure (MAP) and heart rate (HR) were significantly lower in the lidocaine group compared to the placebo group.[11]

In their study on the effects of dexmedetomidine (DEX) on anesthetic requirements, recovery profile, and postoperative morphine use, Bakhamees et al. found that in a cohort of eighty patients, those receiving DEX (0.8 μg/kg bolus followed by 0.4 μg/kg/hr infusion, Group D) showed superior recovery compared to those receiving normal saline (Group P). The authors attributed this improved recovery to a reduction in the amounts of fentanyl and propofol required for anesthesia during surgery.[12]

Norimasa et al. observed similar findings, concluding that postoperative cognitive function was not adversely affected by DEX administration.[13] Conversely, Mohamed et al. reported that patients in the DEX group experienced significantly longer postoperative orientation and extubation times compared to those receiving a placebo. They attributed this delay in recovery to the sedative properties of DEX.[14]

Omar et al. investigated the impact of systemic lidocaine infusion on train-of-four (TOF) ratios during the recovery from general anesthesia. The researchers hypothesized that patients receiving lidocaine would experience a shorter duration between reversal and extubation compared to those receiving a placebo. Their observation of a 15% reduction in the cumulative dose of rocuronium administered intraoperatively supported this hypothesis, suggesting that lidocaine may facilitate faster neuromuscular recovery.[15] In comparison to a placebo, our study found that the infusion of lidocaine and dexmedetomidine did not significantly affect the duration of extubation, the time to patient response to verbal commands, the time to eye opening, or the time required to achieve a modified Aldrete score of at least nine (Table 2).

A lidocaine intravenous injection causes analgesia through various mechanisms. The final analgesic effect is caused by an increase in acetylcholine concentration in the central nervous system (CNS), which also blocks muscarinic receptors M3,[8] inhibits glycine receptors,[9] and releases endogenous opioids.[11] N methyl D aspartate receptor-mediated post-synaptic depolarization can also be directly or indirectly reduced by lidocaine. By acting on potassium channels and releasing adenosine triphosphate, intravenous lidocaine also attenuates tissue damage caused by cytokines and lessens the inflammatory response to tissue ischemia.[12] Unlike lidocaine, DEX affects the locus ceruleus and modifies the noradrenergic pathway that descends from the spinal cord. Additionally, it acts on the spinal cord by activating alpha2 receptors at the dorsal horn's substantia gelatinosa, inhibiting nociceptive neuron firing, and preventing substance P from being released. The spinal, supraspinal, and local mechanisms of action of dexmedetomidine result in a decrease in norepinephrine release and the possibility of analgesia.[16]

Our study demonstrated a reduction in the total dosage of tramadol administered within the first 24 hours for patients receiving lidocaine and dexmedetomidine infusions. Additionally, these patients experienced a longer interval before requiring their first postoperative analgesic dose (Table 3).

These findings align with those of Gurbet et al. Blaudszun G et al. Tauzin-Fin et al. and Kim KT et al. who also reported reduced postoperative analgesic dosages and extended times before the need for first rescue analgesics when lidocaine and dexmedetomidine were used perioperatively.[4,17–19] However, our results contrast with the studies by Martin F et al. Bryson GL et al. and Choi SJ et al. which found that intraoperative lidocaine did not lead to a decrease in postoperative analgesic requirements.[20–22]

The QoR-40 is a comprehensive measure of recovery quality, evaluating five dimensions of health: pain, emotional stability, physical independence, comfort, and patient support. Each aspect is rated on a five-point Likert scale, with scores ranging from 40 (very poor QoR) to 200 (very good QoR).[23]

Our study found that patients receiving lidocaine infusion had the highest QoR-40 scores in the postoperative period, comparable to those in the dexmedetomidine group but significantly better than those in the saline group (Table 4). This improvement may be attributed to lidocaine's effects on reducing inflammation, opioid use, and associated nausea and vomiting. Our findings are consistent with those of Oliveria Jr. GSD et al. who reported enhanced recovery with intravenous lidocaine infusion.[24,25]

In comparing the QoR-40 scores, Group 1 (lidocaine) achieved the highest ratings across all dimensions. Between Groups 2 (saline) and 3 (dexmedetomidine), Group 3 showed better scores in emotional state, psychological support, physical independence, and pain management, though both groups had comparable physical comfort scores (Figure 3).

A limitation of our study was the lack of patient-controlled analgesia (PCA) for postoperative pain management. The use of fixed analgesic dosages can result in peak and trough effects, potentially leading to inadequate pain control. The unavailability of PCA in our setup significantly affected our ability to fully assess

postoperative analgesic requirements.

5. Conclusion

The use of intraoperative infusion of lignocaine and dexmedetomidine was associated with several positive outcomes, including a faster recovery, decreased need for postoperative analgesics, and higher Quality of Recovery (QoR) scores. These improvements suggest that both lignocaine and dexmedetomidine effectively enhance the overall recovery experience by providing better pain management and increasing patient satisfaction. The benefits observed in terms of reduced analgesic consumption and improved QoR scores highlight the potential advantages of incorporating these agents into perioperative care to support a more comfortable and efficient recovery process.

6. Source of Funding

None.

7. Conflict of Interest

None.

Acknowledgments

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