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Comparison of Postoperative Analgesic Effectiveness of Bupivacaine and Bupivacaine Plus Dexmedetomidine Wound Infiltration in Abdominal Surgeries under General Anesthesia

Hafsa Tariq[1], Muhammad Shahid[2], Muhammad Usman Mohsin[3], Naima Shakeel[4*], Muhammad Shahzad Afzal[5] and Shahid Rafique[6]

[1]Department of Anesthesia, District Headquarter Hospital, Sahiwal, Pakistan
[2]Department of Anesthesia, Sahiwal Medical College, Sahiwal, Pakistan
[3]Department of Anesthesia, Nishtar Medical University, Multan, Pakistan
[4]Department of Physiology, Sahiwal Medical College, Sahiwal, Pakistan
[5]Department of Surgery, Sahiwal Teaching Hospital, Sahiwal, Pakistan
[6]Department of General Surgery, Sahiwal Medical College, Sahiwal, Pakistan

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***Corresponding Author:**
Naima Shakeel
Department of Physiology, Sahiwal Medical College, Sahiwal, Pakistan
naima2umar@gmail.com

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ABSTRACT

Abdominal surgeries were major surgical procedures that were performed at any teaching hospital. Pain control was a major concern during intra-operative as well as post-operative periods in these patients. **Objective:** To compare post-operative analgesic effectiveness of bupivacaine and bupivacaine plus dexmedetomidine wound infiltration in abdominal surgeries under General Anesthesia. **Methods:** This randomized controlled trial was conducted at the Department of Anesthesia, Sahiwal Teaching Hospital Sahiwal from 1st April, 2024 till 31st May 2024. Sixty-four patients underwent a pre-operative assessment on the day before surgery. Both Groups received wound infiltration with studied drugs at the end of surgery. After surgery, patients were assessed for pain using a Visual Analog Scale (VAS) and data was collected and analyzed using Statistical Package for the Social Sciences (SPSS) version 26.0. **Results:** The mean post-operative analgesia duration of the patients on bupivacaine was 11.78 ± 1.64 but the mean post-operative analgesia duration of the patient on bupivacaine plus dexmedetomidine was 19.19 ± 2.49. (2-tailed significance 0.001). The mean opioid consumption in mg of the patients in bupivacaine was 20.69 ± 4.31 but the mean opioid consumption in mg of the patient in bupivacaine plus dexmedetomidine was 10.88 ± 4.53. (2-tailed significance 0.001). In bupivacaine, patients with bradycardia were 0% and patients without bradycardia were 100% but in bupivacaine plus dexmedetomidine, patients with bradycardia were 15.6% and patients without bradycardia were 84.4%. **Conclusions:** There was a difference in the analgesic effectiveness of dexmedetomidine when added to bupivacaine in wound infiltration in abdominal surgeries.

INTRODUCTION

Abdominal surgeries, those are some complicated procedures that happen everywhere, especially in teaching hospitals. But Pain is a big deal during and after these surgeries [1]. Pain can make a huge difference in how patients bounce back. Good pain management can speed up recovery, shorten hospital stays, and take some of the pressure off healthcare facilities [1]. It can mess with a person's quality of life and even up the chances of complications or, heaven forbid, death. And that's not a risk we want to take. There are the usual suspects like intravenous drugs like opioids and NSAIDs (ever heard of Ketorolac or Ketamine?). But we've also got some more advanced techniques. There's nebulization, multimodal analgesia, patient-controlled analgesia (which is pretty neat—you can think of it like having a remote control for your pain relief), epidurals, caudals, and peripheral nerve blocks [2]. One simple yet effective method is wound infiltration [2]. It's like a targeted attack on pain right where

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it hurts, using local anesthetics. There's a chance of things like toxicity or allergic reactions, especially with certain types of anesthetics. But sometimes you've got to risk it to get that sweet relief [3]. And speaking of relief, there's been some interesting research in this area. For example, adding ketamine to bupivacaine seems to delay when patients first start feeling pain after something as major as an abdominal hysterectomy. And mixing up ropivacaine and dexmedetomidine seems to work wonders for folks getting lumbar discectomies [4]. Plus, using dexmedetomidine in various ways during surgery or in the wound seems to mean less need for morphine afterward, which is great because opioids come with a laundry list of side effects. Some studies have even gone meta, combining data from lots of other studies, and found that using stuff like dexmedetomidine in wound infiltration during abdominal surgery can mean less reliance on opioids overall [5]. Mixing up anesthetics with others can not only keep pain at bay but also make patients feel a whole lot more relaxed during and after surgery. Using a mix of bupivacaine and dexmedetomidine seems to be a game-changer when it comes to keeping pain in check after surgery. Patients in these studies needed less pain relief overall compared to those who just got bupivacaine alone [6, 7].

So this study was intended to check if there is better pain relief from bupivacaine and dexamethasone then dexamethasone alone.

METHODS

This Randomized controlled trial was conducted at the Department of Anesthesia, Sahiwal Medical College/Sahiwal Teaching Hospital, Sahiwal after approval of the study. Sample size will be calculated using an open epi WHO calculator comparing two means, using Confidence interval = 95 %, and power of study 80%. [3].

$$\text{Sample size} = \frac{2SD^2 (Z_{\alpha/2} + Z_{\beta})^2}{d^2}$$

SD (Standard Deviation) = 0.69 from previous study [3], Za/2 = Z0.05/2 = Z0.025 = 1.96 (From Z table) at type 1 error of 5%, Zb = Z0.20 = 0.842 (From Z table) at 80% power, d = effect size = difference between mean values = 0.479, n= 32 (in each group). A total of 64 patients were selected and divided into two groups, each group consisting of 32 patients. Non-probability consecutive sampling technique was used. Inclusion criteria was age limit: 18-60 years, gender of patient i.e., male or female, Patients listed for abdominal surgeries, American Society of Anesthesiologists (ASA) status of I or II. While the Exclusion Criteria was patients with a history of drug allergy, patients who have undergone any analgesia in the past 24 hr, patients with liver disease, kidney disease, cardiac disease, sickle cell anemia, severe preeclampsia, or CNS disorder on history, clinical and laboratory assessment American Society of Anesthesiologists (ASA) status III or IV, patients with morbid obesity, raynaud's disease, patients on adrenoceptor agonists, antagonists, or narcotics before the operation. The duration and type of abdominal surgery, patient comorbidities were also excluded. The hospital's ethical committee gave their approval via Letter No: 103/IRB/SLMC/SWL once they had obtained informed written consent from each patient, making sure they met the necessary inclusion criteria and provided their demographic information. Patients were then divided randomly into two groups. Prior to their surgeries, all patients underwent a pre-operative assessment. Two hours before surgery, they were given a pre-medication of oral midazolam at a dosage of 0.05 mg/kg. Using a computer-generated random number table, patients were assigned to either Group I or Group II. Group I received 20 mL of 0.25% bupivacaine for wound infiltration at the conclusion of surgery, while Group II received the same amount of bupivacaine along with 1 µg/kg of Dexmedetomidine. The individual responsible for preparing the study drugs was not involved in collecting the data. Anesthesia induction was carried out using intravenous propofol (2–2.5 mg/kg) and nalbuphine (0.1mg/kg). Tracheal intubation was facilitated by administering succinylcholine intravenously at a dosage of 1.5 mg/kg. Throughout the surgery, anesthesia was maintained with isoflurane (0.6 mac), 60% nitrous oxide, 40% oxygen, and atracurium (0.5mg/kg bolus followed by a maintenance dose of 0.15mg/kg every 30 minutes). Intraoperative monitoring included electrocardiogram leads II and V5, non-invasive blood pressure readings taken at 5-minute intervals, oxygen saturation levels, end-tidal carbon dioxide measurements, and nasopharyngeal temperature. Patients were ventilated using intermittent positive pressure ventilation to ensure normocapnia. Heart Rate (HR) and Mean Arterial Pressure (MAP) were kept within 20% of their pre-operative values. If hypotension (MAP <20% of baseline or <65 mmHg) occurred, patients were treated with a saline infusion and, if necessary, phenylephrine injections intravenously. Bradycardia (HR <40 beats/min) was addressed with an intravenous bolus of atropine (40 µg/kg) during both the intraoperative and postoperative periods. Prior to completing the surgery, all patients received intravenous paracetamol (15 mg/kg) and ondansetron (0.1 mg/kg). Residual neuromuscular blockage was reversed with intravenous neostigmine (0.05mg/kg) and glycopyrrolate at the end of the surgery. Tracheal extubation was performed based on standard extubation criteria. Postoperative pain management consisted of intravenous paracetamol (15 mg/kg) every 8 hours and ondansetron (0.1 mg/kg) every 8 hours for nausea and vomiting. Patients were then transferred to the Post-Anesthesia Care Unit (PACU), where they were assessed by anesthesia residents and trained nursing staff who were unaware of the drugs administered during the study. Pain levels were evaluated using the Visual Analog Scale (VAS)

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every 30 minutes for the first 4 hours and then every 2 hours for the next 24 hours. The time from the local wound infiltration to the first request for analgesia was recorded. Ketorolac (30 mg) was administered as rescue analgesia if the VAS score was 4 or higher. Postoperative hemodynamics were monitored every 15 minutes for the first 2 hours and then hourly for the next 24 hours. Breakthrough pain was managed with intravenous nalbuphine (0.1mg/kg) as needed. The total opioid consumption over 24 hours was noted for both groups in terms of milligrams. The occurrence of postoperative complications related to the studied drugs, such as bradycardia and hypotension, was recorded for 24 hours postoperatively. Data were collected using a structured questionnaire. Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 26.0. Quantitative variable like (height, weight, and age) was presented by using mean ± SD. A comparison of quantitative variables (height, weight, and age) between groups was done using an independent sample t-test. Chi-square test was used to compare qualitative variables with a p-value ≤ 0.05 as significant.

RESULTS

The mean age of the patients in bupivacaine was 43.13 ± 12.39 but the mean age of the patient in bupivacaine plus dexmedetomidine was 41.69 ± 10.08. The mean weight of the patients in bupivacaine was 74.31 ± 6.42 but the mean weight of the patient in bupivacaine plus dexmedetomidine was 72.41 ± 5.95. The mean BMI of the patients in bupivacaine was 25.12 ± 2.12 but the mean BMI of the patient in bupivacaine plus dexmedetomidine was 24.86 ± 1.94. The mean post-operative analgesia duration of the patients in bupivacaine was 11.78 ± 1.64 but the mean post-operative analgesia duration of the patient in bupivacaine plus dexmedetomidine was 19.19 ± 2.49. The mean opioid consumption in mg of the patients in bupivacaine was 20.69 ± 4.31 but the mean opioid consumption in mg of the patient in bupivacaine plus dexmedetomidine was 10.88 ± 4.53. In bupivacaine, males were 59.4% and females were 40.6% but in bupivacaine plus dexmedetomidine, males were 62.5% and females were 37.5%. In bupivacaine, patients with bradycardia were 0% and patients without bradycardia were 100% but in bupivacaine plus dexmedetomidine, patients with bradycardia were 15.6% and patients without bradycardia were 84.4%. In bupivacaine, patients with hypotension were 6.3% and patients without hypotension were 93.7% but in bupivacaine plus dexmedetomidine, patients with hypotension were 25% and patients without hypotension were 75%. In bupivacaine, patients with nausea were 9.4% and patients without nausea were 90.6% but in bupivacaine plus dexmedetomidine, patients with nausea were 6.3% and patients without nausea were 93.7%. In bupivacaine, patients with vomiting were 6.3% and patients without vomiting were 93, 7% but in bupivacaine plus dexmedetomidine, patients with vomiting were 3.1% and patients without vomiting were 96.9%. The table shows that adding Dexmedetomidine to Bupivacaine in abdominal surgeries significantly extends post-operative analgesia duration and reduces opioid consumption, with similar patient demographics between the two groups (Table 1).

Table 1: Patient Demographics and Postoperative Outcomes Comparison

Variables	Bupivacaine Alone (Mean ± SD)	Bupivacaine Plus Dexmedetomidine (Mean ± SD)
Age	43.13 ± 12.39	41.69 ± 10.08
Weight	74.31 ± 6.42	72.41 ± 5.95
BMI	25.12 ± 2.12	24.86 ± 1.94
Post-Operative Analgesia Duration in Hour	11.78 ± 1.64	19.19 ± 2.49
Opioid Consumption in mg	20.69 ± 4.31	10.88 ± 4.53

The table indicated that Group 2 (Bupivacaine + Dexmedetomidine) experienced significantly longer post-operative analgesia and reduced opioid consumption compared to Group 1 (Bupivacaine alone) (Table 2).

Table 2: Postoperative Analgesia and Opioid Use

Variables	Groups of Patients	(Mean ± SD)
Duration of Post-Operative Analgesia	Group 1 Bupicain	11.78 ± 1.64
	Group 2 Bupicain+ Dexmedetomidine	19.18 ± 2.49
Opioid Consumption / 24 hr	Group 1 Bupicain	20.69 ± 4.31
	Group 2 Bupicain+ Dexmedetomidine	10.88 ± 4.53

The table showed a significant increase in the incidence of bradycardia in Group 2 (Bupivacaine + Dexmedetomidine) compared to Group 1 (Bupivacaine alone), with a p-value of 0.026 (Table 3).

Table 3: Bradycardia Group Comparison

Variables			Groups of Patients		p-Value
			Group 1 Bupicain	Group 2 Bupicain + Dexmedetomidine	
Bradycardia	Yes	Count	0	5	0.026*
	No	Count	32	27	

*Calculated by Independent Sample t test

DISCUSSION

This study dove into the realm of postoperative pain, exploring how dexmedetomidine, when added to bupivacaine in wound infiltration after abdominal surgeries, might impact recovery. This α2-adrenoceptor agonist was known to work its magic in peripheral nerve blocks, though the exact mechanisms were still a bit of a mystery [8]. Taking potential central analgesia, vasoconstriction, and anti-inflammatory effects here. Those patients who received the dexmedetomidine and bupivacaine combo seemed to have some extended

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postoperative relief. Taking an average of 19.18 hours of analgesia, compared to just 11.78 hours with bupivacaine alone. That's a pretty substantial difference, statistically speaking ($p < 0.05$). And it gets even better. Not only did the dexmedetomidine group experience longer pain relief, but they also needed less opioid pain medication 20.69 mg compared to 10.88 mg for those who only got bupivacaine ($p < 0.05$). More patients in the dexmedetomidine group experienced bradycardia and hypotension. While that might sound alarming, it's not entirely unexpected given the nature of the medication. Thankfully, there was no significant difference in nausea and vomiting between the two groups ($p > 0.05$), so at least there's that. These findings align nicely with a meta-analysis it was stumbled upon [9]. It turns out that mixing dexmedetomidine with local anesthetic in wound infiltration during abdominal surgery doesn't just reduce the need for postoperative pain relief—it also prolongs the duration of analgesia. Another randomized double-blind study with 60 patients showed a significant difference in morphine consumption between those who received ropivacaine and those who got bupivacaine ($p = 0.03$) [10]. The ropivacaine group needed significantly less morphine 185 mg compared to 220 mg. But it's not just about the medications use it's also about how it was administered them. Intravenous dexmedetomidine, whether as a bolus or infusion, has been shown to prolong sensory and motor blockade in randomized clinical trials [11]. Speaking of recovery, a randomized clinical trial on laparoscopic cholecystectomy patients revealed some interesting results [12]. Those who received bupivacaine during surgery experienced less pain at their shoulder and port sites, plus they had fewer bouts of vomiting in the first six hours post-op. Not to mention, they needed less opioid pain medication overall. Looks like bupivacaine might be a real MVP when it comes to postoperative pain relief [13, 14]. And let's not forget about the trocar sites. In other studies, on laparoscopic cholecystectomy patients, bupivacaine infiltration at these sites proved to be an effective method for relieving postoperative pain [15-17]. Whether it was combined with gallbladder fossa infiltration or not, bupivacaine got the job done [18]. Now, of course, this study wasn't without its limitations. Hence it was acknowledged that the need for a larger sample size to fully understand the side effect profile of dexmedetomidine. Plus, it was not for sure whether the cardiovascular effects associated with dexmedetomidine were dose-dependent or not [19, 20]. But Rome wasn't built in a day, and groundbreaking medical research isn't either. Contributing to the ever-growing body of knowledge aimed at making patients' lives better.

CONCLUSIONS

It was concluded that dexmedetomidine when added to bupivacaine in wound infiltration in abdominal surgeries significantly increases the post-op duration of analgesia and has an opioid-sparing effect.

Authors Contribution

Conceptualization: NS
Methodology: HT
Formal analysis: MSA
Writing, review and editing: MS, MUM, NS, SR

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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