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Comparison of the Mean Duration of Postoperative Analgesia of Epidural Dexmedetomidine and Fentanyl as an Adjuvant to 0.2% Ropivacaine in Elective Abdominal Surgeries

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ABSTRACT

Objectives: To compare the mean duration of postoperative analgesia of epidural dexmedetomidine and fentanyl as an adjuvant to 0.2% ropivacaine in elective abdominal surgeries. **Study Design:** Randomized Controlled Trial. **Settings:** Department of Anaesthesia, Doctors Hospital & Medical Centre, Lahore. **Duration of Study:** June 2024 to December 2024. **Materials & Methods:** Patients who were between the ages of 20 and 60 years, had ASA I and II, and were having major abdominal surgery were included. Patients with coagulopathy, significant cardiovascular disease, renal failure, history of allergy to local anesthetics or alpha-2 adrenergic agonists were excluded. Following that, these patients were split into two groups of thirty each at random using the lottery method. Group I-RF (Ropivaciain 0.2% 9 ml with fentanyl 1 µg/kg). Group II-RD (Ropivaciain 0.2% 9 ml with dexmedetomidine 1 µg/kg). The length of analgesia was recorded. The result was displayed as the mean. **Results:** The mean age of patients in groups I and II was 40.93 ± 9.12 and 41.43 ± 8.33 years, respectively. 162.39 ± 10.53 cm was the average height. The mean weight was 72.68 ± 7.53 kg. The mean BMI was 27.75 ± 3.93 kg/m2. The average surgical time for patients in groups I and II was 36.72 ± 6.12 minutes and 39.19 ± 7.28 minutes, respectively. The duration of postoperative analgesia in this trial was 539.89 ± 49.83 in group II and 1362.46 ± 51.15 in group I. **Conclusion:** According to this study, low doses of ropivacaine (0.2%) combined with dexmedetomidine and fentanyl give efficient and long-lasting pain relief without significantly impairing motor function.

INTRODUCTION

The most popular method for successfully relieving postoperative pain after elective abdominal procedures is now epidural analgesia. Anesthesiologists are becoming increasingly concerned about postoperative pain treatment because a smooth postoperative phase makes surgery a comfortable option for surgical patients. When compared to other postoperative analgesic methods like general anesthesia, epidural analgesia offers better analgesia.[1,2] By acting on µ-opioid receptors, a different pain pathway, opioids like fentanyl reduce the amount of local anesthetic needed and provide better analgesia. Furthermore, perioperative epidural analgesia has physiological advantages that could lessen postoperative stress and enhance surgery results. An important part of patient care, postoperative analgesia is vital for promoting an early recovery and lowering morbidity.[3,4]

For both the intraoperative and postoperative phases of elective abdominal procedures, epidural anesthesia is commonly used to provide analgesia. The recommended drugs for epidural anesthesia are local anesthetics such ropivacaine, levobupivacaine, and bupivacaine. They could, however, cause negative side effects such motor blockage, hypotension, and urine incontinence. Dexmedetomidine is a typical local anesthetic used for epidural anesthesia.[5] No matter how it is administered, dexmedetomidine, an α2-adrenergic receptor (α2-AR) agonist, extends the duration of sensory and motor blockage brought on by local anesthetics. As an adjuvant to buprevacaine, opioids like fentanyl are frequently used to lower the dosage, speed up the onset of analgesia, and extend its duration.[6] To get the appropriate anesthetic effect, fentanyl, an opioid analgesic, spars the dose of a local anesthetic. Opioids do have superior analgesia and a dose-sparing impact on local anesthetics, but there is always a chance of a higher risk of respiratory depression, pruritis, urine retention, nausea, and vomiting. Recently, ropivacaine has become more well-liked as a local anesthetic for caudal blocks. By prolonging and intensifying the sensory blockade, adjuvants not only increase the efficacy of a local anesthetic but also lower the dosage of the medication.[7,8]

According to Gandhi et al. (2021), the dexmedetomidine group had a longer mean duration of analgesia than the fentanyl and ropivacaine groups (561.60±66.81 vs. 379.20±82.56, P<0.001).[9]

In addition to local anesthetics like ropivacaine, a variety of medications, including opioids and alpha-2 agonists, have been employed for the same purpose. Adjuvants prolong analgesia and have a dose-sparing impact on local anesthetics. These studies are few. Opioids have greater adverse effects, which lengthen hospital stays and make them a secondary option for analgesia. In order to determine the mean duration of the postoperative analgesic effect, which can help reduce the use of opioids in the postoperative period and help reduce the mortality, morbidity, and cost of the entire treatment, the study aims to repeat this clinical trial in the local population.

METHODOLOGY

This randomized controlled trial investigation was carried out by the Department of Anaesthesia at Doctors Hospital & Medical Centre in Lahore between June and December of 2024. The Institutional Review Board granted ethical approval. The expected mean duration of postoperative analgesia in patients undergoing elective abdominal surgery treated with dexmedetomidine plus ropivacaine group 561.60±66.81 was longer than that of the fentanyl group and the ropivacaine group 379.20±82.56, respectively.[9] The sample size of 60 cases (30 in each group) is calculated with 80% power of test and 95% confidence interval. Patients who were between the ages of 20 and 60 years, had ASA I and II, and were having major abdominal surgery were included. Patients with coagulopathy (INR>1.0), significant cardiovascular disease (ejection fraction < 45%), renal failure (serum creatinine > 1.2 mg/dl), infection at the injection site as confirmed by history, physical examination, and lab reports, history of alpha-2 antagonist treatment, history of allergy to local anesthetics or alpha-2 adrenergic agonists, and pregnant or lactating females were excluded.

They received counseling and an explanation of the study's specifics. Each patient provided written informed permission and a thorough medical history. Following that, these patients were split into two groups of thirty each at random using the lottery method.

Group I-RF (Ropivaciain 0.2% 9 ml with fentanyl 1 µg/kg). Group II-RD (Ropivaciain 0.2% 9 ml with dexmedetomidine 1 µg/kg).

Alprazolam 0.5 mg tablets were given to each patient at bedtime, and they were kept at zero per month in accordance with the fasting regimen prior to operation. A 10% povidone iodine solution was used to drain the patient's back while they were in the left lateral position. Two milliliters of 2% lignocaine were used to anesthetize the skin over the T11-T12 interspace while maintaining all aseptic precautions. This epidural space was punctured with an 18G Touhy needle, as evidenced by the loss of resistance to air technique. After that, a 19G epidural catheter was inserted through the needle into the epidural space and progressed at least 3–4 cm. To ensure that the catheter was positioned correctly, 4 milliliters of xylocaine with adrenaline 1:200,000 were given as tests.

Each case was treated using the standard general anesthetic method, which includes induction, maintenance, and extubation. Intravenous (IV) paracetamol and 400 mg of ibuprofen were administered as part of a multimodal strategy to pain management using the WHO ladder of pain management. Following the patient's transfer to the post-anesthesia care unit (PACU), one of the two groups received an epidural medication provided based on visual analogue scales (VAS≥3) for the first complaint of discomfort. Group RD (ropivacaine + dexmedetomidine) received ropivacaine 0.2% 9 ml plus dexmedetomidine 1 mcg/kg, while Group RF (ropivacaine + fentanyl) received ropivacaine 0.2% 9 ml plus fentanyl 50 mcg.

The length of analgesia was recorded (measured in minutes, beginning five minutes after the drug was administered via epidural catheter and ending when the patient's visual analog score was ≥3, indicating the need for analgesia to relieve pain). The result was displayed as the mean. Along with the patient's demographic information, all of the data was documented and entered into the proforma that is attached. To reduce bias and control confounding variables, the same anesthesia department consultant performed all epidural catheter insertions.

SPSS version 29 was used to enter and analyze all of the data that was gathered. Age, BMI, length of operation, and length of analgesia were among the numerical variables that were displayed using mean ±SD and range. The mean duration of analgesia in the two groups was compared using the t-test. Gender, a categorical variable, was displayed as a percentage and frequency. Age, gender, BMI, and length of operation were used to stratify the data. The post-stratification T-test was used, and a p-value of less than 0.05 was considered statistically significant.

RESULTS

Age was 41.19 ± 8.72 on average. The mean age of patients in groups I and II was 40.93 ± 9.12 and 41.43 ± 8.33 years, respectively. 162.39 ± 10.53 cm was the average height. The mean weight was 72.68 ± 7.53 kg. The mean BMI was 27.75 ± 3.93 kg/m2. The average surgical time for patients in groups I and II was 36.72 ± 6.12 minutes and 39.19 ± 7.28 minutes, respectively. The distribution of patients by a number of variables is shown in Table 1.

Table 2 shows that the duration of postoperative analgesia in this trial was 539.89 ± 49.83 in group II (Ropivaciain 0.2% 9 ml with dexmedetomidine 1 µg/kg) and 1362.46 ± 51.15 in group I (Ropivaciain 0.2% 9 ml with fentanyl 1 µg/kg). Table 3 shows how the length of postoperative analgesia is stratified by confounders.

Table 1

Distribution of Different Variables (n=60)

		Group I- RF (n=30)	Group II- RD (n=30)
		Number (%)	Number (%)
Age (years)	20-40	11 (36.67%)	12 (40.0%)
	41-60	19 (63.33%)	18 (60.0%)
Gender	Male	13 (43.33%)	10 (33.33%)
	Female	17 (56.67%)	20 (66.67%)
BMI (kg/m²)	≤25	11 (36.67%)	12 (40.0%)
	>25	19 (63.33%)	18 (60.0%)
Duration of surgery (min)	≤30	21 (70.0%)	20 (66.67%)
	>30	09 (30.0%)	10 (33.33%)

Table 2
Comparison of the Mean Duration of Postoperative Analgesia of Epidural Dexmedetomidine and Fentanyl as an Adjuvant to 0.2% Ropivacaine in Elective Abdominal Surgeries

	Group I- RF (n=30)	Group II- RD (n=30)	p-value
	Mean ± SD	Mean ± SD	
Duration of postoperative analgesia (min)	362.46 ± 51.15	539.89 ± 49.83	0.0001

Table 3
Stratification of Duration of Postoperative Analgesia with Respect to Confounders

		Group I- RF (n=30)	Group II- RD (n=30)	P-value
		Duration of postoperative analgesia (min)	Duration of postoperative analgesia (min)	
		Mean ± SD	Mean ± SD	
Age (years)	20-40	354.62 ± 57.43	541.76 ± 51.23	0.0001
	41-60	364.71 ± 48.97	538.67 ± 48.75	0.0001
Gender	Male	371.24 ± 61.32	545.32 ± 52.61	0.0001
	Female	342.53 ± 43.39	534.71 ± 46.59	0.0001
BMI (kg/m^2)	≤25	358.53 ± 59.45	542.86 ± 50.72	0.0001
	>25	363.29 ± 60.93	540.52 ± 49.68	0.0001

DISCUSSION

When added to low-concentration ropivacaine (0.20%) in epidural anesthesia, dexmedetomidine and fentanyl both effectively relieve postoperative pain without causing severe motor blockage. As evidenced by a longer duration of analgesia, lower VAS scores, the absence of rescue analgesia, and generally lower drug intake, dexmedetomidine, on the other hand, provides higher analgesic efficacy. These results are in line with earlier research and provide credence to the idea that dexmedetomidine is a better epidural adjuvant for improved postoperative pain control in elective abdominal operations.

The effectiveness of dexmedetomidine and fentanyl as adjuvants to low-concentration ropivacaine (0.2%) in postoperative epidural analgesia for patients undergoing elective abdominal operations was assessed in this study. Since general anesthesia was used for intraoperative anesthesia, the epidural catheter was purposefully positioned at the T11-T12 interspace to offer efficient postoperative analgesia. This dosage was chosen to minimize the possibility of significant cephalad dissemination and opioid-related adverse effects while ensuring adequate segmental coverage of the lower abdomen and pelvic dermatomes (T10-S1).

In order to achieve a loading dose and minimize intraoperative opioid requirements, the epidural infusion started one hour following the surgical incision. For the first 24 hours after extubation, a continuous basal infusion via PCEA allowed for accurate monitoring of medication consumption and pain management. Our findings demonstrated that at the end of the second postoperative hour, a goal sensory block level at T10 was regularly reached and sustained.

Prior research comparing dexmedetomidine and fentanyl with local anesthetics for epidural usage has consistently demonstrated that dexmedetomidine produces better analgesic results.[10-13] Our results corroborate this pattern, showing that dexmedetomidine was linked to better pain levels at different postoperative time points, fewer requests for boluses, and reduced overall medication consumption.

When Bajwa et al. used a single bolus of 0.75% ropivacaine for lower limb procedures, they found that dexmedetomidine produced longer-lasting analgesia than fentanyl.[14] In line with our work, they used 1 µg/kg of fentanyl and excluded PCEA completely. In Bajwa's trial, the fentanyl group needed rescue analgesia sooner than the dexmedetomidine group (366.62 ± 24.42 minutes) (242.16 ± 23.86 minutes). Similarly, the duration of postoperative analgesia was 539.89 ± 49.83 in group II (Ropivaciain 0.2% 9 ml with dexmedetomidine 1 µg/kg; p-value = 0.0001) and 1362.46 ± 51.15 in group I (Ropivaciain 0.2% 9 ml with fentanyl 1 µg/kg).

In a study of 56 patients undergoing surgery for a femoral neck fracture, Akhondzadeh et al.[10] discovered that the dexmedetomidine group experienced a noticeably longer duration of sensory block (311.2 ± 60.3 minutes) than the fentanyl group (226.6 ± 46.1 minutes; P = 0.045). Additionally, dexmedetomidine had shorter onset periods for both sensory and motor block (3.5 ± 0.6 minutes and 17.5 ± 1.9 minutes, respectively) than fentanyl (6.0 ± 1.1 minutes and 22.6 ± 2.2 minutes; P < 10%). There were fewer rescue analgesics needed (2.54 ± 1.36 mg vs. 3.15 ± 1.64 mg; P < 0.05) and lower VAS scores (4.9 ± 0.6 vs. 5.8 ± 0.9; P < 0.001). Even if surgical populations varied, our results show that dexmedetomidine has an improved analgesic profile.

At 4, 8, 12, 16, 20, and 24 hours after surgery, VAS pain scores were shown to be statistically significant between the two groups in a study; the corresponding p-values were 0.034, 0.002, 0.004, 0.001, 0.005, and 0.023. With a p-value of 0.0001, the RD group's total drug consumption during and after surgery was 138.47 ± 2.67 mL, whereas the RF group's was 144.53 ± 4.19 mL. This difference is extremely significant. With a p-value of 0.0001, the average number of bolus doses administered in a 24-hour period was 3.067 ± 1.23 in Group RD and 5.267 ± 2.09 in Group RF. Neither group needed rescue analgesia, and no patient had any signs of motor blockage. There were no appreciable differences in hemodynamic parameters between the groups.[15]

The effectiveness of epidural bupivacaine with dexmedetomidine and epidural bupivacaine with fentanyl for postoperative pain management was examined in a study by Ayyappan and Santhanakarishnan.[16] They came to the conclusion that in epidural bupivacaine, dexmedetomidine works better as an adjuvant than fentanyl. It may result in longer postoperative analgesia, a quicker sensory and motor block, and less need for rescue analgesia. The results of the current investigation are in line with the previously described findings.[16]

The findings demonstrated that compared to patients in the fentanyl group, those in the dexmedetomidine group had greater and more obvious sedation scores. According to Chiruvella et al., Oriol-López and Maldonado-Sánchez performed a prospective research on 40 patients receiving epidural anesthesia for abdominal surgery.[17] They contrasted 3 mg/kg of lidocaine and epinephrine with 1

µg/kg of dexmedetomidine. According to Ramsey, who was quoted in Chiruvella et al., the sedation score was achieved. Ramsey received a score of 3 after five minutes and 3–4 after fifteen to ninety minutes. They demonstrated that a single bolus epidural dosage of dexmedetomidine produced adequate drowsiness in 10 and 120 minutes.[17] The outcomes of the current study, Bajwa et al.'s study[14], and Akhondzadeh et al.'s study[10] are all in line with the previously described outcome.

Patients receiving dexmedetomidine experienced a longer duration of analgesia and a quicker onset of anesthesia, according to a comprehensive review and meta-analysis conducted by Qian et al.[18] This study compared fentanyl with dexmedetomidine in 672 individuals. When added to bupivacaine in patients undergoing general anesthesia, Alansary and Elbeialy compared fentanyl and dexmedetomidine.[19] They discovered that during the postoperative phase, dexmedetomidine outperformed fentanyl in terms of pain management. The results of these trials are consistent with our findings of improved analgesia with dexmedetomidine. When added to epidural local anesthetics, dexmedetomidine works better than fentanyl in other kinds of procedures as well.[20-22]

Dexmedetomidine thereby provides improved analgesic quality and lowers medication doses without raising the possibility of side effects. Although both adjuvants are safe and efficient, dexmedetomidine seems to be the better option for patients having abdominal procedures who want better postoperative pain management.

Our study's emphasis on a homogeneous surgical group and its use of PCEA for objective outcome assessment are two of its main advantages. Park et al. noted a gap in the literature about the need for studies that include continuous epidural infusions, which this design fills.[23] Accurate assessment of postoperative analgesic results was made possible by the combination of general and epidural anesthesia.

Our study's main drawback is its short observation period, which is only available for the first 24 hours after surgery. The single-center design and small sample size are other restrictions. Deeper insights may be obtained with a longer follow-up with a bigger sample, especially with relation to delayed side effects or prolonged analgesic efficacy.

CONCLUSION

According to this study, low doses of ropivacaine (0.2%) combined with dexmedetomidine and fentanyl give efficient and long-lasting pain relief without significantly impairing motor function. Overall, dexmedetomidine and fentanyl were both successful in managing postoperative pain; however, dexmedetomidine showed a comparable hemodynamic safety profile, a potentially better quality of analgesia, and a lower total ropivacaine consumption.

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