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Evaluation of the Efficacy of 0.20% Ropivacaine with Dexmedetomidine versus 0.20% Ropivacaine Alone for Transversus Abdominis Plane Block in Infra-Umbilical Surgery: A Randomized Controlled Study

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Abstract: ***Background: Postoperative pain management is a critical component of surgical recovery. The Transversus Abdominis Plane (TAP) block has emerged as an effective regional anesthesia technique for abdominal surgeries. This study evaluates the efficacy of adding dexmedetomidine to ropivacaine in TAP blocks to enhance postoperative analgesia. Methods: This prospective, randomized, double - blinded, controlled study was conducted at the Department of Anaesthesiology, HITECH Medical College and Hospital, Bhubaneswar, from 2023 to 2025. Sixty ASA I - II patients, aged 18–60, undergoing infra - umbilical surgery under spinal anesthesia were randomized into two groups: RS (0.20% Ropivacaine with saline) and RD (0.20% Ropivacaine with dexmedetomidine 1 mcg/kg). Postoperative analgesia was assessed using the Visual Analog Scale (VAS), time to first rescue analgesia, total tramadol consumption, and hemodynamic parameters. Results: Patients in the RD group had significantly prolonged analgesia compared to the RS group (10.80±6.38 vs.2.80±0.99 hours, p<0.001). VAS scores were significantly lower in RD at all time points. Total tramadol consumption was significantly reduced in RD (48.33±20.69 mg vs.105±15.25 mg, p<0.001). No significant adverse effects were noted. Conclusion: The addition of dexmedetomidine to ropivacaine in TAP block significantly prolongs analgesia, reduces opioid consumption, and enhances patient comfort without notable side effects. This combination can be recommended for improved postoperative pain management in infra - umbilical surgeries.***

Keywords: TAP block, ropivacaine, dexmedetomidine, postoperative analgesia, infra - umbilical surgery

1. Introduction

Pain, a complex sensory and emotional experience, requires effective management as a crucial component of enhanced recovery protocols in surgery. Effective postoperative pain control improves patient satisfaction, reduces complications, and promotes early mobilization. The Transversus Abdominis Plane (TAP) block is a well - established technique for managing postoperative pain in abdominal surgeries. This study explores the impact of adding dexmedetomidine, an alpha - 2 adrenergic agonist with analgesic and sedative properties, to ropivacaine in TAP blocks.

2. Materials and Methods

Study Design and Population: This prospective, randomized, double - blinded, controlled study was conducted at the Department of Anaesthesiology, HITECH Medical College and Hospital, Bhubaneswar, from 2023 to 2025. Sixty ASA I - II patients, aged 18–60, scheduled for infra - umbilical surgery under spinal anesthesia were randomized into two groups: RS (0.20% Ropivacaine with saline) and RD (0.20% Ropivacaine with dexmedetomidine 1 mcg/kg). Postoperative analgesia was assessed using the Visual Analog Scale (VAS), time to first rescue analgesia, total tramadol consumption, and hemodynamic parameters.

Exclusion Criteria:

- BMI >35 kg/m2
- ASA III - V status
- Allergy to study drugs
- Contraindications to subarachnoid block

Randomization and Intervention: Patients were randomized into two groups:

- **Group RS:** 40 ml of 0.20% Ropivacaine with 2 ml saline
- **Group RD:** 40 ml of 0.20% Ropivacaine with dexmedetomidine (1 mcg/kg) diluted to 2 ml

Procedure:

- Subarachnoid block was administered using 0.5% hyperbaric bupivacaine.
- TAP block was performed using the landmark - guided double - pop technique.
- Hemodynamic parameters were monitored postoperatively at 0, 2, 4, 6, 8, 12, and 24 hours.
- Pain was assessed using the VAS scale, and rescue analgesia was administered if VAS >4.
- Sedation levels were monitored using the Ramsay Sedation Scale.

Outcome Measures:

- Primary: Duration of analgesia (time to first rescue analgesia)
- Secondary: Total tramadol consumption in 24 hours,

hemodynamic stability, and side effects

3. Results

Demographics: The groups showed no significant differences in age, BMI, weight, or height.

Pain Scores and Analgesic Consumption:
- VAS scores were significantly lower in RD at all time points.
- Time to first rescue analgesia was significantly longer in RD (10.80±6.38 vs.2.80±0.99 hours, p<0.001).
- Total tramadol consumption was significantly lower in RD (48.33±20.69 mg vs.105±15.25 mg, p<0.001). (tables are in the figure section)

Hemodynamic Stability and Adverse Effects:
- No significant adverse events (bradycardia, hypotension, nausea, vomiting) were observed in either group.
- RD group exhibited better hemodynamic stability postoperatively.

4. Discussion

Post - Surgical Pain (VAS Score):
- In contrast, patients receiving ropivacaine alone (Group RS) experienced insufficient analgesia beyond 4 hours.
- **Group RD (ropivacaine + dexmedetomidine)** showed significantly **lower VAS scores** at different time intervals (**Chen Q et a**, **Nag DS et al**).

Time to First Rescue Analgesia:
- **Group RD: 10.80±6.38 hours** pain - free duration.
- **Group RS: 2.80±0.99 hours**, requiring earlier analgesia.
- Similar results were reported by **Sarvesh B et al**, where dexmedetomidine addition prolonged analgesia to **8.8±2.29 hours** vs.5**.47±1.27 hours** (**p<0.001**).
- Findings supported by **Almarakbi WA et al**, **Sinha J et al**, **Chen Q et al**, **Marhofer D et al**.

Opioid Consumption (Tramadol Use in 24 Hours):
- **Group RD: 48.33 ± 20.69 mg** of tramadol.
- **Group RS: 105 ± 15.25 mg**, indicating higher opioid requirement.
- Findings aligned with **Luan H et al**, who observed reduced PCA demand in dexmedetomidine groups.
- Similar reductions in opioid use were reported by **Sinha J et al**, **Zhang X et al**, **Almarakbi WA et al**, **Sarvesh B et al**.

Safety & Side Effects:
- No significant side effects (bradycardia, hypotension, syncope, arrhythmias, neuropathy, etc.).
- No complications related to TAP block administration.

5. Conclusion

Adding dexmedetomidine to 0.20% ropivacaine in TAP blocks significantly prolongs postoperative analgesia, reduces opioid consumption, and provides better pain control without significant side effects. This combination offers a promising alternative for effective pain management in infra - umbilical surgeries.

6. Limitations

1) Plasma levels of dexmedetomidine were not measured to differentiate between local and systemic effects.
2) The onset time of the TAP block was not assessed due to the residual effect of spinal anesthesia.
3) The relatively small sample size limits generalizability; larger studies could yield more definitive conclusions.

7. Future Recommendations

Further large - scale, multicentric studies with ultrasound - guided TAP blocks and pharmacokinetic analysis of dexmedetomidine are recommended to validate these findings and optimize regional anesthesia protocols.

Figure:

Table 1: Age distribution in the study population (n=60)

	Group				p Value	Implication
	Group RS		Group RD			
	Mean	Std. Deviation	Mean	Std. Deviation		
Age Year	45.27	0.54	47.37	0.47	0.525	Not Significant

Table 2: Weight distribution in the study population

	Group				p Value	Implication
	Group RS		Group RD			
	Mean	Std. Deviation	Mean	Std. Deviation		
Weight	65.12	0.92	62.74	0.79	0.621	Not Significant

Table 3: Height distribution in the study population

	Group				p Value	Implication
	Group RS		Group RD			
	Mean	Std. Deviation	Mean	Std. Deviation		
Height	1.58	0.03	1.57	0.03	0.912	Not Significant

Table 4: The average BMI (Body Mass Index) of the study population

	Group				p Value	Implication
	Group RS		Group RD			
	Mean	Std. Deviation	Mean	Std. Deviation		
BMI	25.64	0.49	25.24	0.53	0.686	Not Significant

Table 5: The average duration of the surgery in the study population

	Group				p Value	Implication
	Group RS		Group RD			
	Mean	Std. Deviation	Mean	Std. Deviation		
Surgery Duration	67.20	4.12	64.50	4.42	0.044	Not Significant

Table 6: Mean Systolic Blood Pressure at different time duration in the study population

	Group					
	Group RS		Group RD			
	Mean	Std. Deviation	Mean	Std. Deviation	p Value	Significance
SBP: 0 HOUR	121.53	6.81	121.43	5.56	0.951	Not Significant
SBP: 2HOUR	123.67	6.48	121.20	5.78	0.012	Significant
SBP: 4HOUR	123.63	6.33	121.43	5.51	0.035	Significant
SBP: 6 HOUR	122.90	6.50	121.60	5.56	0.656	Not Significant
SBP: 8 HOUR	123.17	7.15	123.10	5.22	0.967	Not Significant
SBP: 12 HOUR	121.83	6.51	122.80	6.61	0.545	Not Significant
SBP: 24 HOUR	121.30	6.34	121.00	5.43	0.845	Not Significant

Table 7: Mean diastolic pressure at different time duration in the study population

	Group				p Value	Significance
	Group RS		Group RD			
	Mean	Std. Deviation	Mean	Std. Deviation		
DBP: 0 HOUR	79.10	3.89	78.13	4.25	0.363	Not Significant
DBP: 2HOUR	80.33	4.50	77.9	4.05	0.032	Significant
DBP: 4HOUR	80.83	3.61	78.3	3.88	0.011	Significant
DBP: 6 HOUR	80.43	3.86	78.6	4.37	0.091	Not Significant
DBP: 8 HOUR	80.97	3.65	79.2	3.59	0.064	Not Significant
DBP: 12 HOUR	79.37	3.16	79.17	5.18	0.858	Not Significant
DBP: 24 HOUR	79.27	3.73	78.23	4.24	0.301	Not Significant

Table 8: Mean heart rate at different time duration in the study population

	Group				p Value	Significance
	Group RS		Group RD			
	Mean	Std. Deviation	Mean	Std. Deviation		
HR: 0 HOUR	73.7	8.14	74.17	6.03	0.802	Not Significant
HR: 2HOUR	76.93	9.14	74.53	5.97	0.028	Significant
HR: 4HOUR	75.87	8.08	74.97	5.90	0.036	Significant
HR: 6 HOUR	75.67	8.14	75.23	5.61	0.811	Not Significant
HR: 8 HOUR	76.83	8.85	76.47	5.72	0.624	Not Significant
HR: 12 HOUR	73.9	7.77	75.93	7.18	0.297	Not Significant
HR: 24 HOUR	73.57	7.89	74.70	5.87	0.531	Not Significant

Table 9: Mean blood oxygen saturation levels at different time duration in the study population

	Group				p Value	Significance
	Group RS		Group RD			
	Mean	Std. Deviation	Mean	Std. Deviation		
SPO_2: 0 HOUR	99.90	0.30	99.80	0.55	0.388	Not Significant
SPO_2: 2HOUR	99.90	0.30	99.90	0.30	1	Not Significant
SPO_2: 4HOUR	99.97	0.18	99.97	0.18	1	Not Significant
SPO_2: 6 HOUR	100	0.00	100	0.00	0.167	Not Significant
SPO_2: 8 HOUR	100	0.00	100	0.00	NA	Not Significant
SPO_2: 12 HOUR	99.97	0.18	99.87	0.34	NA	Not Significant
SPO_2: 24 HOUR	100	0.00	100	0.00	NA	Not Significant

Table 10: Mean VAS (Visual Analogue Scale) score at different time duration in the study population

	Group					
	Group RS		Group RD			
	Mean	Std. Deviation	Mean	Std. Deviation	p Value	Significance
VAS: 0 HOUR	0.00	0.00	0.00	0.00	NA	NA
VAS: 2HOUR	4.96	1.56	1.10	0.92	**<0.001**	**Significant**
VAS: 4HOUR	4.50	1.92	2.20	1.56	**<0.001**	**Significant**
VAS: 6 HOUR	3.83	2.29	2.60	1.83	**<0.001**	**Significant**
VAS: 8 HOUR	5.06	1.50	5.03	1.88	0.940	Not Significant
VAS: 12 HOUR	2.86	1.22	4.66	1.84	**<0.001**	**Significant**
VAS: 24 HOUR	1.9	1.09	3.9	0.30	**<0.001**	**Significant**

Table 11: Average amount of rescue analgesia administered to the study participants at different time duration after TAP block

	Group				p Value	Significance
	Group RS		Group RD			
	Mean	Std. Deviation	Mean	Std. Deviation		
RESCUE ANALGESIA: 0 HOUR	0.00	0.00	0.00	0.00	NA	NA
RESCUE ANALGESIA: 2HOUR	30.00	24.91	0.00	0.00	<0.001	Significant
RESCUE ANALGESIA: 4HOUR	21.67	25.2	3.33	12.68	<0.001	Significant
RESCUE ANALGESIA: 6 HOUR	20.00	24.91	6.67	17.28	0.019	Significant
RESCUE ANALGESIA: 8 HOUR	28.33	25.2	21.67	25.20	0.310	Not Significant
RESCUE ANALGESIA: 12 HOUR	5	15.25	16.67	23.97	0.028	Significant
RESCUE ANALGESIA: 24 HOUR	0.00	0.00	0.00	0.00	NA	NA

Table 12: Average total amount of rescue analgesia administered to the study participants

	GROUP				p Value	Significance
	GROUP RS		GROUP RD			
	Mean	Std. Deviation	Mean	Std. Deviation		
Total Rescue Analgesia	105.00	15.25	48.33	20.69	<0.001	Significant

Table 13: The average sedation score in the study population

	GROUP				p Value	Significance
	GROUP RS		GROUP RD			
	Mean	Std. Deviation	Mean	Std. Deviation		
SEDATION SCORE: 0 HOUR	2.00	0.00	2.00	0.00	NA	NA
SEDATION SCORE: 2HOUR	1.50	0.50	2.00	0.00	<0.001	Significant
SEDATION SCORE: 4HOUR	1.60	0.49	1.96	0.18	<0.001	Significant
SEDATION SCORE: 6 HOUR	1.60	0.49	1.86	0.34	0.019	Significant
SEDATION SCORE: 8 HOUR	1.43	0.50	1.56	0.50	0.310	Not Significant
SEDATION SCORE: 12 HOUR	1.9	0.30	1.66	0.47	0.028	Significant
SEDATION SCORE: 24 HOUR	2.00	0.00	2.00	0.00	NA	NA

Table 14: The average pain free duration in the study population

	Group				p Value	Significance
	Group RS		Group RD			
	Mean	Std. Deviation	Mean	Std. Deviation		
Pain Free Period (Hours)	2.8	0.99	10.8	6.38	<0.001	Significant

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