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Original Research Article

A Comparative Clinical Study of Intraoperative Haemodynamic Response and Post-Operative Analgesic Effect in Laparoscopic Appendectomy under Spinal Anaesthesia with Adjuvants versus General Anaesthesia with Tap Block

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Abstract

Laparoscopic appendectomy is a common surgical procedure that requires effective anaesthesia and analgesia. This study aims to compare the intraoperative hemodynamic response and postoperative analgesic effect of spinal anaesthesia with adjuvants versus general anaesthesia with TAP block in patients undergoing laparoscopic appendectomy. This prospective, randomized, compared clinical study included 60 patients undergoing laparoscopic appendectomy. Patients were randomly allocated to one of two groups: Group A (n=30) received spinal anaesthesia with adjuvants (Bupivacaine and Buprenorphine), while Group B (n=30) received general anaesthesia with TAP block (Bupivacaine). Intraoperative hemodynamic parameters and postoperative pain scores (VAS) and any adverse events were recorded. Group A had a more stable intraoperative hemodynamic profile compared to Group B ($p < 0.01$). Postoperative pain scores were significantly lower in Group A at 2, 4, and 6 hours after surgery ($p < 0.05$). Additionally, Group A required less postoperative analgesia ($p < 0.01$) and had a lower incidence of postoperative nausea and vomiting ($p < 0.05$). This study demonstrates that spinal anaesthesia with adjuvants provides a more stable intraoperative hemodynamic response and better postoperative analgesia compared to general anaesthesia with TAP block in patients undergoing laparoscopic appendectomy. These findings suggest that spinal anaesthesia with adjuvants may be a preferred anaesthesia technique for this surgical procedure.

Keywords: Laparoscopic Appendectomy, Spinal Anaesthesia, General Anaesthesia, Haemodynamics, Post Operative Analgesia.

Introduction

Laparoscopic appendectomy, a widely practiced surgical procedure, has transformed the management of acute appendicitis with its minimally invasive approach, resulting in reduced recovery time and postoperative complications [1]. However, optimizing anaesthetic techniques remains a cornerstone in ensuring intraoperative stability and effective postoperative pain management [2].

Spinal anaesthesia, often combined with adjuvants, offers the advantage of regional block with minimal systemic effects, promoting better hemodynamic control during surgery [3]. In contrast, general anaesthesia, when paired with targeted techniques like transversus abdominis plane (TAP) block, provides focused analgesia by blocking the abdominal wall nerves, potentially minimizing opioid requirements post-operatively. Both approaches have unique implications on patient outcomes, including intraoperative haemodynamic stability, postoperative pain relief, and overall recovery experience [4].

This study aims to compare the intraoperative haemodynamic response and postoperative

analgesic efficacy of spinal anaesthesia with adjuvants versus general anaesthesia combined with transversus abdominis plane (TAP) block in patients undergoing laparoscopic appendectomy. By evaluating these parameters, the research seeks to contribute to evidence-based anaesthetic strategies that optimize patient care and enhance the surgical experience in minimally invasive settings.

Aim and Objectives

1. To compare intra-operative haemodynamic response and post-operative analgesic effect in laparoscopic appendectomy under spinal anaesthesia with adjuvant versus General anaethesia with TAP block.
2. To evaluate and compare the post-operative analgesic effectiveness- compare the time to first request for analgesia in the two anaesthesia groups, to assess the total analgesic consumption in the first 24 hours post operatively.
3. To document and compare any adverse events or complications.

Materials and Method

Duration of the Study: One (1) year

Study Site: Fakhruddin Ali Ahmed Medical College & Hospital.

Ethical Clearance: The nature and purpose of the study were explained to the Fakhruddin Ali Ahmed Medical College & Hospital and ethical clearance was obtained with the institutional review board.

Sample Size: The study will utilize a sample of 30 patients in each group, determined through convenient sampling.

Sample Size Calculation: According to the study done by Liet al [5] (2020), considering VAS score postoperatively Group A as 27%, Group B as 73%, at 95% confidence interval with 80% power, the sample size is calculated.

Considering 10% drop out, the minimum sample size required for each group is 33 and the total sample size is 66. To round up sample size was taken as 70.

Study Design: Participants meeting the inclusion criteria will be randomized into two groups:

- **Group A**: Spinal anesthesia with adjuvant.
- **Group B**: General anesthesia with TAP (Transversus Abdominis Plane) block.

Inclusion Criteria:

1. Age: 18-60 years.
2. Diagnosis: Appendicitis requiring elective laparoscopic appendectomy.
3. ASA Classification: ASA I or II.

Exclusion Criteria:

1. **Complicated Appendicitis**: Cases requiring open appendectomy or complex surgical intervention for complication like perforation, pregnant individuals, known Allergies.
2. **Contraindications to Anesthesia**: Any medical history indicating risks with spinal anesthesia or TAP block.

Informed Consent: Informed consent (bilingual) was obtained from the participants who were chosen based on inclusion criteria.

Recruitment of Study Subjects: Among the total of 70 participants, 60 participants who met the inclusion and exclusion criteria were identified. The nature and purpose of the study were explained to them, and consent forms were given to obtain permission for taking part in the study. Here on, sixty who were willing to participate and those signed and returned the consent form were selected and allocated randomly between two groups, consisting of thirty subjects in each arm.

Procedure, Preparation, and Technique:

Patient Selection and Consent: Post-ethical approval, 30 eligible patients per group will be randomly assigned to receive either spinal anesthesia with an adjuvant or general anesthesia with a TAP block. Diagnosis will be based on clinical assessment and supporting diagnostic tests.

Preoperative Assessment: A comprehensive medical history, physical examination, and preoperative labs will be conducted to ensure patient suitability.

Anesthesia Administration:

Group A (Spinal Anesthesia with Adjuvant): At the level of L2-L3 lumber interspace vertebrae using 25-gauge spinal needle 15 mg hyperbaric 0.5% bupivacaine with 60 mcg buprenorphine in a total volume 3.2 ml injected intrathecally.

The level of anesthesia was checked to a sensory blockade up to T4. The sensory block level was assessed by the pinprick test using a 24- gauge hypodermic needle, while the motor block level was assessed by the modified Bromage scale.

Group B (General Anesthesia with TAP Block): In this group, 1st induction was done with 2.5 mg/kg of propofol, 2mcg/kg of fentanyl, Succinylcholine 1.5mg/kg for intubation and Atracurium was used as muscle relaxant. Transversus abdominal plane (TAP) block was performed in a double pop technique with 10 ml of 0.25% bupivacaine bilaterally after putting the patient on general anaesthesia.

Continuous recording of hemodynamic parameters, including blood pressure, heart rate, and oxygen

saturation was done intraoperatively.

Postoperative Analgesia:

- **Group A**: Pain managed according to spinal anesthesia guidelines.
- **Group B**: Pain managed using TAP block protocols.

Statistical Procedures: The following statistical procedures were carried out:

Data compilation and presentation: Data obtained were compiled systematically in Microsoft Excel spreadsheet. The dataset was subdivided and distributed meaningfully and presented as graphs and tables.

Statistical analysis: Statistical analyses were performed using SPSS software version 25.0. Descriptive statistics were performed to know the distribution of study participants based on demographic details. Kolmogorov-Smirnov and Shapiro-Wilks normality tests were used to check whether the variables follow normal distribution. Since the curve followed a normal distribution, independent sample t test/Unpaired t test will be performed. P value of <0.05 was considered to be statistically significant.

Results and Analysis: To analyze the data SPSS (IBM SPSS Statistics for Windows, Version 26.0, Armonk, NY: IBM Corp. Released 2019) is used. Significance level is fixed as 5% ($\alpha = 0.05$). P-value <0.05 is considered to be statistically significant.

Demographic Characteristics: The demographic details of the study participants were analyzed in terms of age, weight, height, and BMI. Both Group A (Spinal Anaesthesia with Adjuvant) and Group B (General Anaesthesia with TAP Block) had comparable distributions, as reflected by the non-significant p-values. The mean age, weight, height, and BMI did not show significant differences, ensuring that the groups were well-matched and that any observed differences in outcomes were attributable to the anaesthesia type rather than demographic variations.

Gender Distribution (Table 1)

Table 1: Gender Difference between The Study Groups

Gender	Groups				Total
	Group A		Group B		
	Count	Column N %	Count	Column N %	Column N %
Female	19	63.33%	17	56.67%	60.00%
Male	11	36.67%	13	43.33%	40.00%
Chi-square test, p=0.732					

ASA Classification (Table 2): The ASA (American Society of Anesthesiologists) status was evaluated between the two groups. The proportions of ASA I and ASA II patients were nearly identical, with no significant difference (p=0.539). This suggests a similar baseline health status among participants.

Table 2: Distribution of Asa between the Study Groups

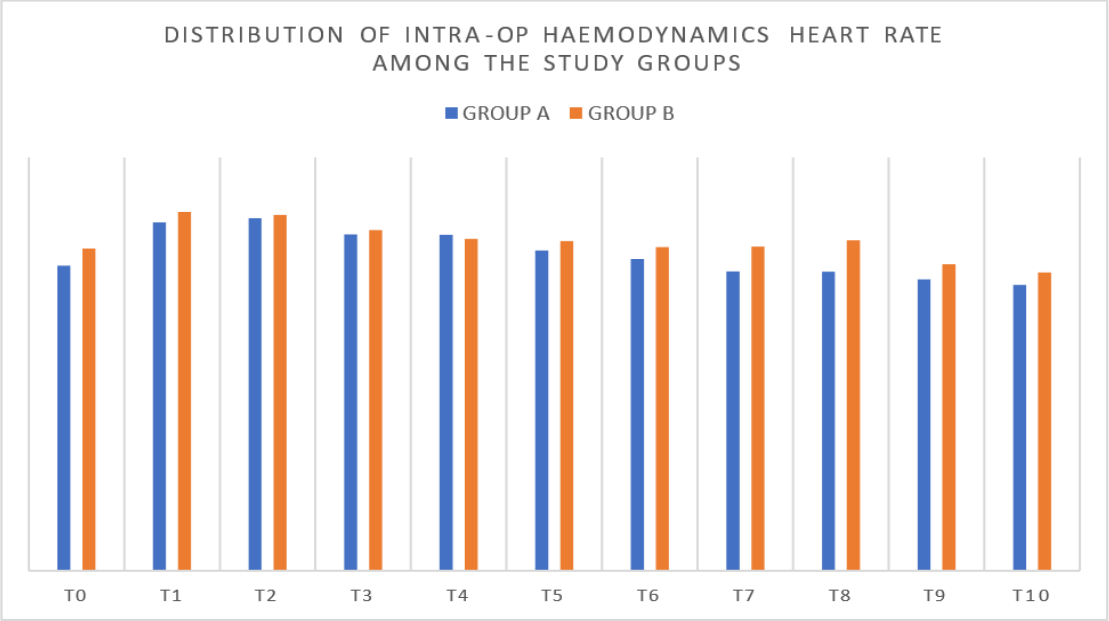
ASA status	Groups				Total	
	Group A		Group B			
	Count	Column N %	Count	Column N %	Count	Column N %
ASA I	17	56.06%	18	59.09%	35	57.58%
ASA II	13	43.94%	12	40.91%	25	42.42%
Chi-square test, p=0.539						

Surgical Duration (Table 3)

Table 3: Distribution of Duration of Surgery between the Study Groups

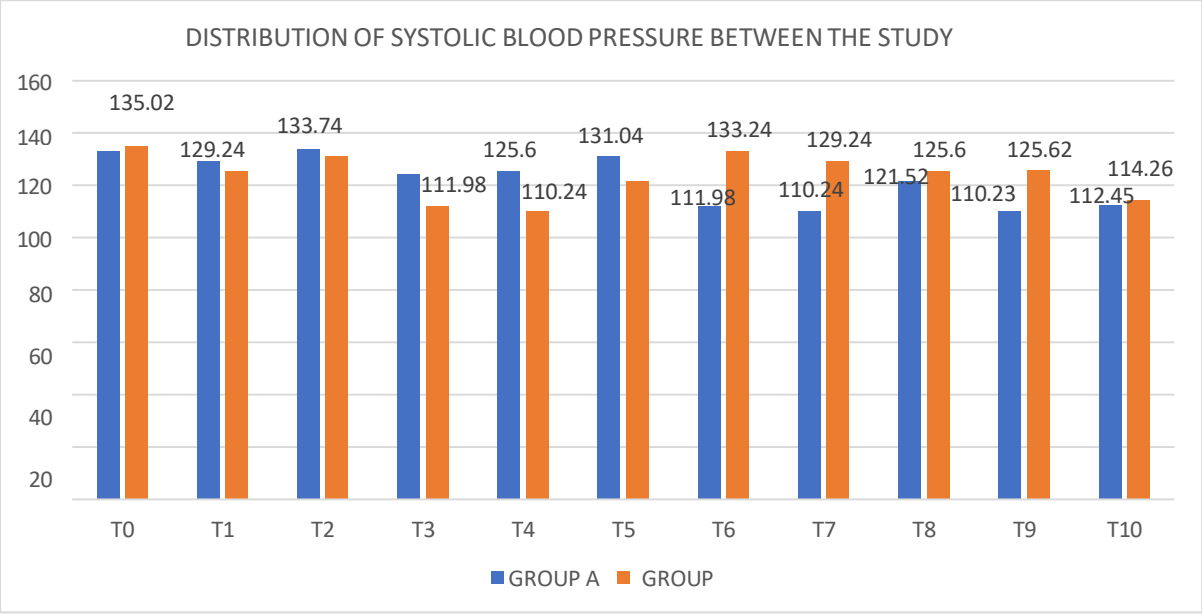
Duration of Surgery (Min.)			
Groups	N	Mean	Std. Deviation
Group A	30	90.20	26.59
Group B	30	88.00	11.90
Total	60	84.10	26.08
p-value	0.734; Independent t-test		

Intraoperative Haemodynamics Heart Rate Variability (Graph 1)



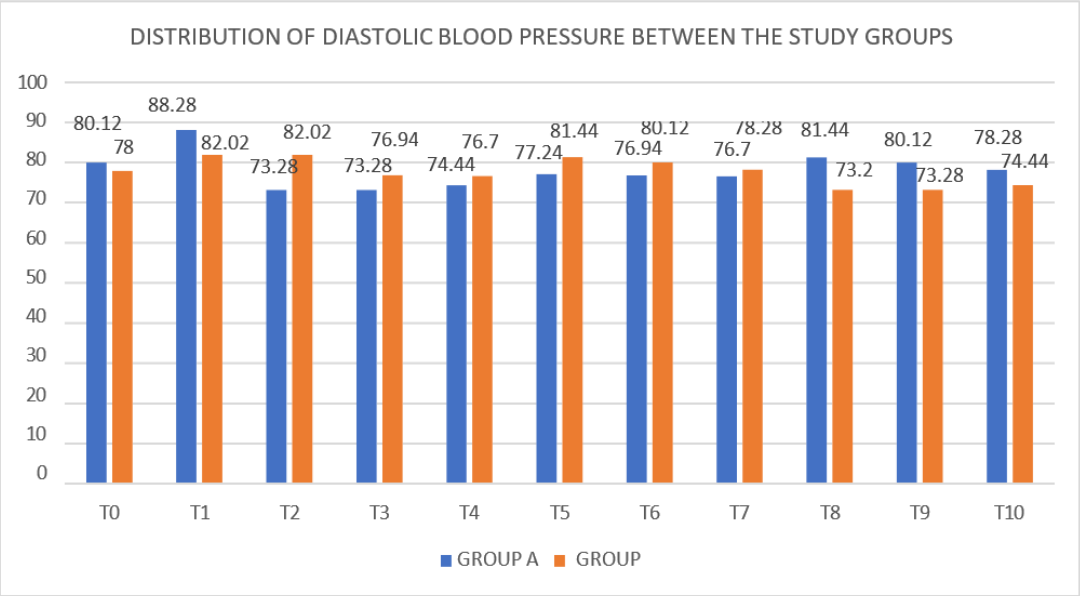
Graph 1: Distribution of Intra-Op Hemodynamics (Heart Rate) Among the Study Groups the Study Groups

Systolic Blood Pressure Trends (Graph 2): Systolic blood pressure remained relatively stable in both groups, with no significant intergroup variations at different time intervals ($p>0.05$). Group B exhibited slightly lower systolic blood pressure at 10 and 15 minutes, possibly due to the systemic effects of GA and TAP block.



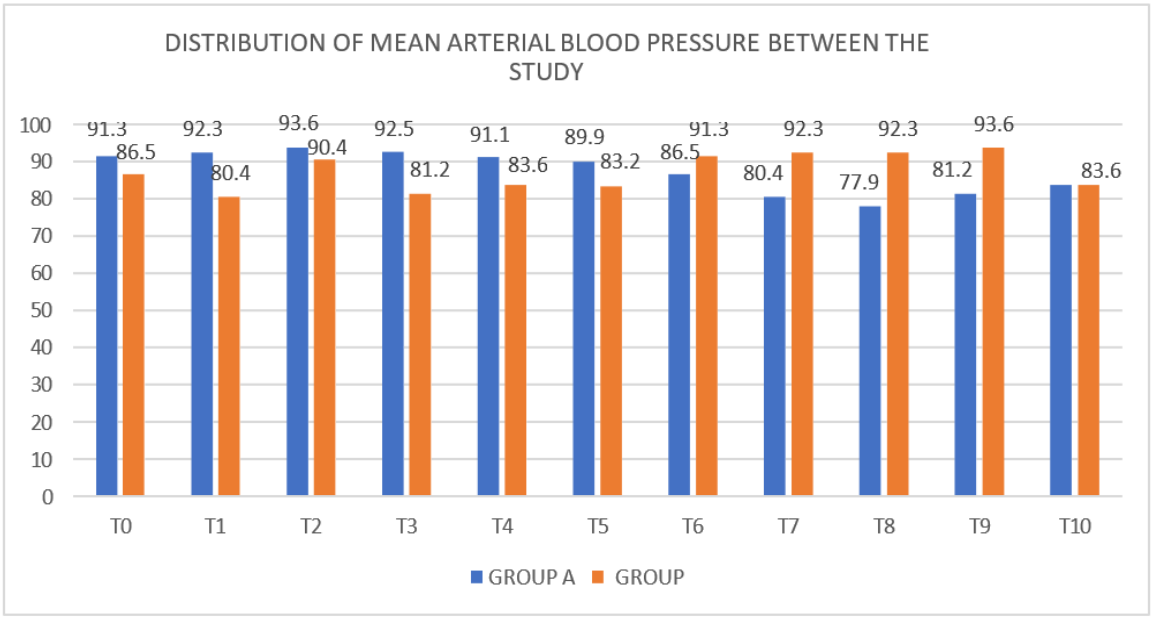
Graph 2: Distribution of Systolic Blood Pressure between the Study Groups

Diastolic Blood Pressure Trends (Graph 3): Both groups demonstrated similar diastolic blood pressure variations, with minor reductions seen in Group A due to the sympathetic blockade effect of spinal anaesthesia. The differences between groups were not statistically significant, indicating comparable haemodynamic control.



Graph 3: Distribution of Diastolic Blood Pressure between the Study Groups

Mean Arterial Pressure (Graph 4): Mean arterial pressure (MAP) followed a stable pattern in both groups, with no statistically significant differences ($p>0.05$). Group A exhibited slightly lower MAP during certain intraoperative phases, consistent with the effects of spinal anaesthesia.



Graph 4: Distribution of Mean Arterial Blood Pressure between the Study Groups

Intraoperative Adverse Events (Table 4): Intraoperative adverse events in spinal anaesthesia group were seen. Shoulder pain was observed in 4 patients and anxiety was seen in 3 patients. Shoulder pain was managed with 1–2 µg/kg intravenous Fentanyl. Patients suffered from anxiety, was managed with 0.015-0.030 mg/kg intravenous Midazolam.

Table 4: Distribution of Intraoperative Adverse Events between the Study Groups

Adverse Events	Groups				
	Group A		Group B		p-value
Anxiety	3	10%	0		0.238
Shoulder pain	4	13.33%	0		0.112
Respiratory distress	0	0.00%	0	0.00%	NA

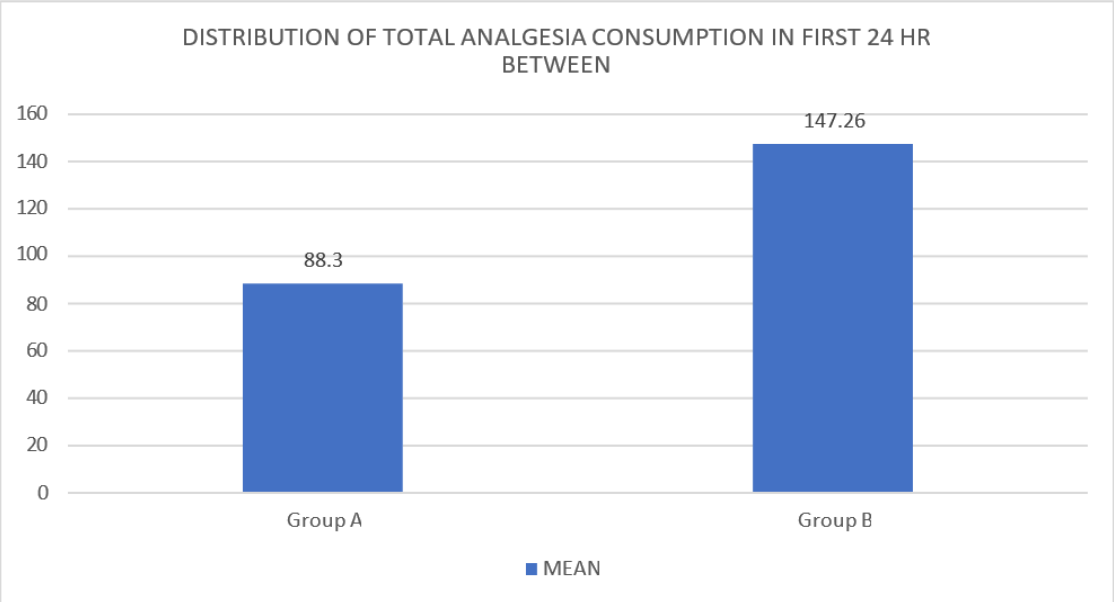
Post-Operative Analgesia and Pain Control

1. Time to First Rescue Analgesia (Table 5): The mean time to first rescue analgesia was significantly longer in Group A (48.23 ± 3.90 min) compared to Group B (29.44 ± 6.53 min) ($p<0.001$). This suggests that spinal anaesthesia with adjuvant provided superior immediate post-operative analgesia.

Table 5: Distribution of Post Op Analgesia between the Study Groups

Time to 1st Rescue Analgesia			
Groups	**N**	**Mean**	**Std. Deviation**
Group A	**30**	**48.23**	**3.90**
Group B	**30**	**29.44**	**6.53**
p-value	**<0.001***; Independent t-test**		

2. Total Analgesia Consumption in the First 24 Hours (Graph 5)

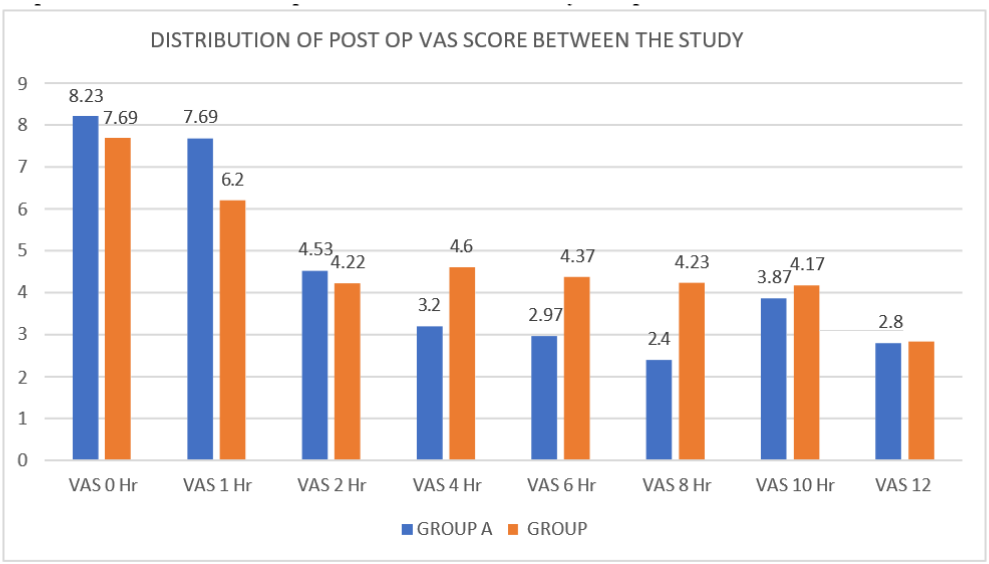


Graph 5: Distribution of Total Analgesia Consumption

3. Post-Operative Vas Scores (Table 6, Graph 6): VAS scores showed that Group A had significantly lower pain scores at various time points, particularly at 4, 6, and 8 hours post-operatively ($p<0.05$). This indicates that spinal anaesthesia provided superior pain relief in the early post-operative period.

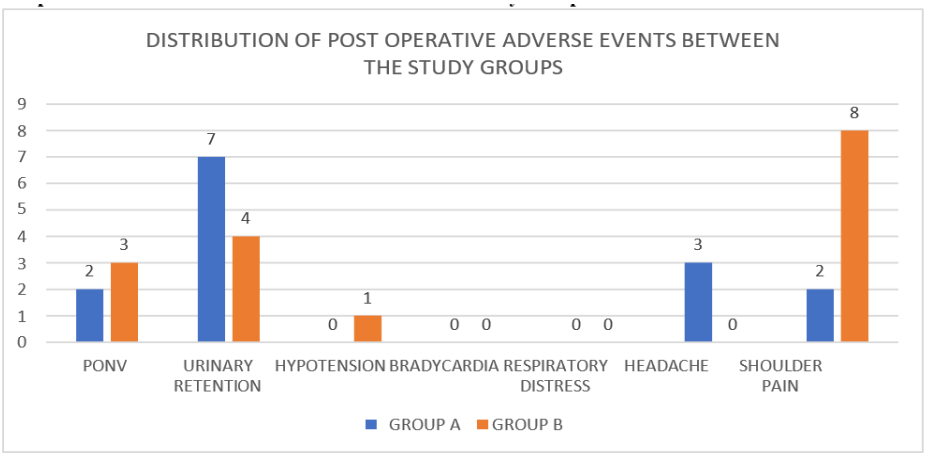
Table 6: Distribution of Post Op Vas Score between the Study Groups

Post-Op VAS score	Group				
	Group A		Group B		p-value
	Mean	Std. Deviation	Mean	Std. Deviation	
VAS 0 Hr	8.23	0.23	7.69	0.20	0.234
VAS 1 Hr	7.69	0.20	6.20	0.21	0.522
VAS 2 Hr	4.53	0.17	4.22	0.13	0.349
VAS 4 Hr	3.20	0.03	4.60	0.02	0.023
VAS 6 Hr	2.97	1.07	4.37	0.67	0.001
VAS 8 Hr	2.40	0.72	4.23	0.82	0.001
VAS 10 Hr	3.87	0.90	4.17	0.79	0.183
VAS 12 Hr	2.80	0.76	2.83	0.65	0.433



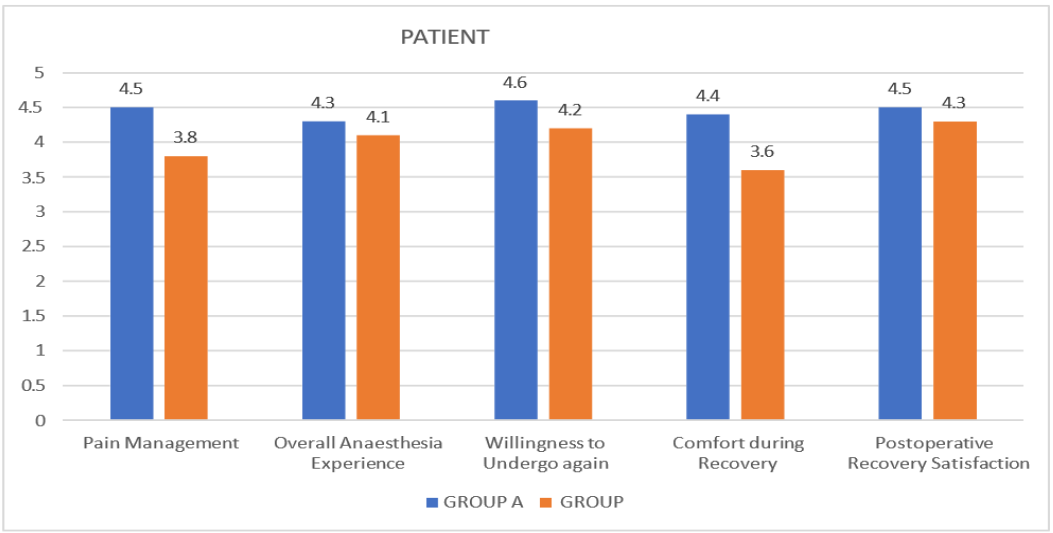
Graph 6: Distribution of Post Op Vas Score between the Study Groups

4. Adverse Events (Graph 7)



Graph 7: Distribution of Adverse Events between the Study Groups

5. Table for Patient Satisfaction (Graph 8)



Graph 8: Patient Satisfaction

Discussion

Laparoscopic appendectomy is the preferred surgical approach for managing acute appendicitis due to its minimally invasive nature, reduced post-operative pain, and faster recovery time. The choice of anaesthesia significantly influences intraoperative haemodynamic stability and post-operative analgesia. This comparative clinical study evaluates the intraoperative haemodynamic response and post-operative analgesic effect in patients undergoing laparoscopic appendectomy under spinal anaesthesia (SA) with an adjuvant versus general anaesthesia (GA) with a transversus abdominis plane (TAP) block [6,7].

Intraoperative Haemodynamic Response [8]

Haemodynamic stability during surgery is crucial for patient safety and optimal surgical conditions. Patients under SA generally experience a reduction in heart rate and blood pressure, which may require vasopressor support in some cases.

Conversely, GA induces a more controlled haemodynamic response, the administration of inhalational agents and opioids helps in maintaining intraoperative stability. The combination of GA with a TAP block has shown to provide improved perioperative analgesia, reducing the requirement for systemic opioids, and thereby minimizing opioid-induced haemodynamic variability.

In my study it was found that in the intraoperative period, heart rate fluctuations were observed in both groups. While Group A (spinal anaesthesia with adjuvants) showed a trend of slight bradycardia over time, Group B (general anaesthesia with Tap block) maintained relatively higher heart rates. However, none of the time points demonstrated statistically significant differences. Group A exhibited slightly lower MAP during certain intraoperative phases, consistent with the effects of spinal anaesthesia. But no such significant differences seen between two groups. Our study was consistent with finding of Pradhan et al [9] where mean arterial pressure and mean heart rate were lower in spinal anaesthesia group than group general anaesthesia though the difference was not statistically significant.

Post-Operative Analgesic Effect

In our study, the mean time to 1st rescue analgesia was significantly longer in group A with 48.23 ± 3.90 min compared to group B with 29.44 ± 6.53 min ($p<0.001$). Similarly, in a study done by Kaya Egur et al [10] it was found that onset of post-operative pain was 8.56 ± 8.13 min in group with general anaesthesia and 138.67 ± 41.50 min in spinal anaesthesia group ($P<0.001$). In our study, we found that total analgesic consumption in group A (spinal anaesthesia with adjuvant) was 88.30 ± 32.60 mg and in group B (General anaesthesia with TAP block) was 147.26 ± 22.49 mg ($P<0.001$). Total analgesic consumption received post operatively in group A was significantly less than group B. This finding of our study was consistent with the finding of Kaya Egur et al [10] who compared spinal anaesthesia versus general anaesthesia in laparoscopic gynecological surgery.

In our study, we also compared the patient VAS score during the post-operative period, and we found a significant difference between the two groups at 4th, 6th and 8th hours. No significant differences were seen at 0, 1st and 2nd hour. The finding of our study was consistent with the finding of Mehanna AMAM et al [11], who compared general anaesthesia versus spinal anaesthesia in laparoscopic appendectomy. According to their study, post-operative pain as measured by VAS score was in favor of spinal anaesthesia group throughout the post-operative period at 1st, 2nd, 3rd, 12th hour with P value<0.001.

Patients receiving SA with adjuvants often report lower pain scores in the initial post-operative hours. However, as the spinal blockade wears off, supplementary analgesics {e.g. tramadol) may be needed [12,13]. On the other hand, GA combined with a TAP block provides effective regional analgesia targeting the anterior abdominal wall. The TAP block, administered after intubation, prolongs analgesia into the post-operative period and reduces the dependency on systemic analgesics. The block effectively covers somatic pain but may be less effective for visceral pain, necessitating additional multimodal analgesic strategies [12,13].

Adverse Effect

Postoperatively, Nausea and vomiting (PONV) were slightly higher in Group B (General anaesthesia with TAP block =10%) than in Group A (spinal anaesthesia with adjuvants = 6.6%), but this was not statistically significant (p=0.72). Urinary retention was more common in Group A (50% vs. 23.33%), likely due to the neuraxial blockade. Post operatively headache was also seen in SA (spinal anaesthesia) group. Shoulder pain was greater in GA (general anaesthesia) with TAP block group of about 26% than SA (spinal anaesthesia) of 6.6%.

The findings of our study is consistent with the study of Kaya Egur et al [10] where they found post-operative nausea vomiting more significant in general anaesthesia (14 patients,46.6%) group than spinal anaesthesia (4 patients,13.3%) (p=0.005). In a study conducted by Erdem et al [16], they found post-operative shoulder pain was significantly greater in general anaesthesia group. They also found post-operative nausea and vomiting was also higher in GA group than spinal-epidural group.

Patient and surgeon satisfaction

In this study, we evaluated satisfaction levels from both patients and surgeons regarding two anaesthetic techniques:

Patient Satisfaction: Patients who received spinal anaesthesia reported better pain relief and greater comfort during recovery, with these differences being statistically significant ($p < 0.01$). This aligns with studies done by Kaya Eguretal [10] indicating that spinal anaesthesia can lead to improved postoperative pain control compared to general anaesthesia.

Surgeon Satisfaction: From the surgeon's perspective, spinal anaesthesia was associated with higher satisfaction in terms of muscle relaxation, postoperative pain control, and overall operative conditions, with fewer anaesthesia-related delays ($p < 0.05$). These findings are consistent with research done by Kaya Egur et al [10].

Comparison Of Outcomes [14,15]

Studies comparing these two anaesthetic techniques have demonstrated that patients undergoing SA with adjuvants experience less intraoperative haemodynamic fluctuations but may require careful monitoring for hypotension and bradycardia. Meanwhile, GA with a TAP block ensures stable intraoperative conditions and a smoother emergence from anaesthesia. Regarding post-operative pain control, both techniques provide effective analgesia, though SA with an adjuvant may offer superior pain relief in the early post-operative period.

However, GA with a TAP block ensures prolonged analgesia, reducing the total opioid requirement and minimizing opioid-related side effects such as nausea, vomiting, and respiratory depression. Future research should focus on large-scale randomized controlled trials comparing these modalities to establish standardized anaesthetic protocols that optimize patient outcomes in laparoscopic appendectomy. Additionally, exploring the combination of these techniques for enhanced perioperative analgesia could offer further improvements in patient care.

Limitation of the Study

The sample size was relatively small and limited to a single center, which may affect the generalizability of the results. The follow-up period was restricted to 24 hours, so long-term outcomes were not assessed. Additionally, the use of adjuvants only in the spinal group may have influenced analgesic comparisons. The study also lacked blinding, which may introduce observer bias.

Conclusion

Spinal anesthesia is effective and safe in patients undergoing laparoscopic appendicectomy. It is cost effective and an efficient approach. Less postoperative pain, less postoperative nausea, vomiting, and shoulder pain are the advantages of spinal anaesthesia compared to general anaesthesia. Patient satisfaction is also improved through a significant decrease in the lack of vomiting and possible lower pain scores. However, the addition of TAP block in general anaesthesia minimizes opioid consumption but has a shorter analgesic duration compared to spinal anaesthesia.

Therefore, it has been recommended that there is an increase in the usage of spinal anaesthesia for laparoscopic appendicectomy in comparison to general anaesthesia with Transversus abdominis plane block.

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