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RESEARCH ARTICLE

ANALGESIC EFFICACY OF ULTRASOUND-GUIDED TRANSVERSUS ABDOMINIS PLANE BLOCK IN PATIENTS UNDERGOING LAPAROSCOPIC APPENDICECTOMY

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Abstract

Background: This study investigates the analgesic efficacy of ultrasound-guided Transversus Abdominis Plane (TAP) block versus traditional analgesics in Laparoscopic appendicectomy patients. It focuses on pain reduction, opioid side effects, and recovery parameters, aiming to improve postoperative care by integrating more precise and safer regional anesthesia techniques.

Methods: This randomized, controlled, double-blinded study at a tertiary care center evaluated the ultrasound-guided TAP block's analgesic efficacy in patients undergoing Laparoscopicappendicectomy. Adults meeting specific criteria were assigned to receive either the TAP block or standard analgesia. Outcomes measured included postoperative pain intensity, analgesia use, patient satisfaction, recovery metrics, and safety, analyzed via intention-to-treat with statistical significance set at $p<0.05$.

Results: Pain scores with movement differed significantly between the groups. Group A had a low mean VAS score of 0.24 (SD 0.44, range 0-1.0), whereas Group B experienced higher discomfort, with a mean score of 1.88 (SD 0.67, range 1.0-4.0). Over time, Group A's pain levels remained low, peaking slightly at 0.80 at 12 hours, then decreasing. Conversely, Group B's pain increased significantly, peaking at 3.24 at 6 hours and gradually reducing to 1.88 by 24 hours. Group A (TAP Block) required fewer analgesics, averaging 1.28 interventions (SD 0.46) versus Group B (Standard), which needed more, averaging 3.48 (SD 0.51).

Conclusion: Ultrasound-guided TAP block reduces pain, analgesic use, and side effects in appendicectomypatients, promising improved recovery outcomes.

Introduction:-

Pain management is a critical component of postoperative care, influencing patient recovery, satisfaction, and overall outcomes.[1]Laparoscopic appendicectomy, a common surgical intervention for acute appendicitis, often results in moderate to severe postoperative pain. Traditionally, this pain has been managed through systemic analgesics, including opioids, which carry the risk of side effects such as nausea, vomiting, constipation, and respiratory depression.[2] The quest for effective pain management techniques with minimal adverse effects has led to the exploration of regional anesthesia as a promising alternative.

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The Transversus Abdominis Plane (TAP) block is aone of the method of regional anaesthesia.It has gained attention for its efficacy in reducing the postoperative pain following abdominal surgeries,.[3]The TAP block targets the sensory nerves of the anterior abdominal wall, thereby providing analgesia to the parietal peritoneum, skin, and muscles incised during surgery.[4]The advent of ultrasound-guided techniques for administering the TAP block has significantly improved its accuracy, safety, and effectiveness, allowing for precise localization of the anatomical landmarks and real-time visualization of the needle and local anesthetic spread.[5]

Despite the growing body of literature supporting the use of the TAP block in various abdominal surgeries, there is a paucity of research focusing specifically on its application in Laparoscopic appendicectomy.[6] This gap underscores the need for targeted studies to evaluate the analgesic efficacy of the ultrasound-guided TAP block in this patient population, considering the unique aspects of the surgical procedure and the postoperative pain profile.[2]

The rationale behind exploring the analgesic efficacy of the ultrasound-guided TAP block in patients undergoing Laparoscopic appendicectomy stems from several considerations.[3] Firstly, the potential for enhanced pain control with fewer opioid-related side effects could significantly improve patient outcomes, including reduced hospital stay, faster recovery, and decreased incidence of chronic pain syndromes.[7] Secondly, the ultrasound-guided approach to the TAP block offers a higher degree of precision and safety, potentially increasing the success rate of the block and further reducing postoperative pain.[7]

Furthermore, the specific focus on Laparoscopic appendicectomy as a surgical model is justified by the procedure's prevalence and the typical pain trajectory experienced by patients.[8] The procedure provides a unique opportunity to assess the impact of the TAP block on a surgical population characterized by acute onset abdominal pain, necessitating timely and effective analgesia. Additionally, evaluating the TAP block in this context contributes to the broader literature on pain management strategies in abdominal surgery, addressing a gap in evidence for a common surgical intervention.[9]

The primary objective of this study is to assess the analgesic efficacy of the ultrasound-guided TAP block in patients undergoing Laparoscopic appendicectomy compared to traditional systemic analgesia. This will be measured through various outcomes, including the intensity of postoperative pain, the consumption of rescue analgesia, patient satisfaction with pain management, and the incidence of opioid-related side effects.

Secondary objectives include evaluation of postoperative nausea &vomiting (PONV). Additionally, this study aims to assess the safety of the ultrasound-guided TAP block in the context of Laparoscopic appendicectomy, monitoring for any procedure-related complications.

By addressing these objectives, the study seeks to provide comprehensive evidence on the value of integrating the ultrasound-guided TAP block into the pain management protocol for patients undergoing Laparoscopic appendicectomy.[10] The findings could have significant implications for clinical practice, potentially leading to revised guidelines that favor regional anesthesia techniques over systemic analgesics for postoperative pain management in this patient population.

Materials &Methods:-

Study Design

This study was a randomized, controlled, double-blinded study conducted to evaluate the analgesic efficacy of the ultrasound-guided Transversus Abdominis Plane (TAP) block in patients undergoing Laparoscopic appendicectomy. The study was approved by the Institutional Review Board (IRB) and was registered with a clinical trials registry. All participants provided written informed consent before participation.

Study Location

This study was done at a tertiary care centre'sAnaesthesia department, enrolling adult patients scheduled for electiveLaparoscopicappendicectomy. Recruitment occurred over a period of six months, following approval by the Institutional Review Board.

Study Duration
The study duration included the time from initial patient recruitment to the completion of the final postoperative assessment at 24 hours post-surgery. This timeframe allowed for a detailed evaluation of the analgesic efficacy of the ultrasound-guided Transversus Abdominis Plane block versus standard systemic analgesia.

Participants
Participants were recruited from a tertiary care center's general surgery department.

Inclusion Criteria:
1. Age Range: Patients aged 18 years to 60 years.
2. Diagnosis: Patients scheduled for elective Laparoscopicappendicectomybased on clinical and radiological findings.
3. Consent: Patients who have given written informed consent to participate in the study.
4. ASA Physical Status: Patients with American Society of Anesthesiologists (ASA) Physical Status Classification I-II.
5. Understanding: Patients who are able to understand and comply with study procedures and requirements.

Exclusion Criteria:
1. Allergy: Patients with known allergy to local anaesthetics or any components used in the TAP block procedure.
2. Previous Abdominal Surgery: Patients with a history of major abdominal surgery, as previous surgeries could alter the anatomy relevant for the TAP block procedure.
3. Coagulopathy: Patients with known coagulation disorders or on anticoagulant therapy that cannot be paused, as this could increase the risk of bleeding complications from the block procedure.
4. Infection: Patients with infection at the proposed site of injection, which could spread with the procedure.
5. Chronic Pain Medication Use: Patients on chronic opioid or analgesic therapy.
6. Cognitive Impairment: Patients with cognitive impairments that might hinder their ability to provide informed consent or accurately report pain scores.
7. Pregnancy: Pregnant patients, due to potential risks to the fetus and the altered anatomy, which may affect the procedure’s efficacy and safety.
8. Emergency Surgery: Patients requiring emergency Appendicectomy, as the urgency of the condition may not allow for the detailed consent process or preoperative preparation required for participation in the study.

Intervention
Patients in the intervention group received an ultrasound-guided mid axillary TAP block with 20 ml of 0.25% bupivacaine on the operative side, administered by a trained anesthesiologist prior to surgery. The procedure was performed using a high-frequency linear ultrasound transducer to visualize the abdominal wall layers and guide the needle insertion. The control group received systemic analgesia according to the hospital's standard postoperative pain management protocol, which included intravenous opioids as needed.

Outcome Measures
The primary outcome measure was the intensity of postoperative pain, assessed using a Visual Analog Scale (VAS) at rest and during movement at 0-, 2-, 4-, 6-, 8-, 12-, 16-, 20-, and 24-hours post-surgery. Secondary outcomes included consumption of rescue analgesia, patient satisfaction with pain management (assessed through a 5-point Likert scale), incidence of opioid-related side effects, and incidence of postoperative nausea and vomiting (PONV). Safety assessments for the TAP block included monitoring for procedural complications such as hematoma, infection, and local anesthetic systemic toxicity.

Randomization and Blinding
Randomization was performed using computer-generated random numbers, with allocation concealment ensured by sealed opaque envelopes. Both participants and outcome assessors were blinded to the group assignments. The anesthesiologist performing the TAP block was not involved in postoperative assessments.

Statistical Analysis
Data were analyzed on an intention-to-treat basis. Continuous variables were compared using independent t-tests or Mann-Whitney U tests, depending on their distribution. Categorical variables were analyzed using the Chi-square

test or Fisher's exact test as appropriate. A p-value of less than 0.05 was considered statistically significant. All analyses were performed using statistical software.

Results:-

Table 1:- Demographic and Clinical Characteristics of Study Participants.

Characteristic	Description
Age	Mean: 38.46, Std: 10.81, Min: 19, Max: 60
Sex	Male (M): 26, Female (F): 24
Weight (kg)	Mean: 61.9, Std: 8.92, Min: 45, Max: 80
ASA Grade	1: 35, 2: 15 (Most common: 1)
Duration of Surgery (min)	Mean: 80.12, Std: 16.26, Min: 50, Max: 110

The study participants, with an average age of 38.46 (SD 10.81, range 19-60 years), were almost evenly split between males (26) and females (24). Average weight was 61.9 kg (SD 8.92, range 45-80 kg). Most were classified as ASA Grade 1 (35 participants), while 15 were Grade 2. The average duration of surgery was 80.12 minutes (SD 16.26, range 50-110 minutes).

Table 2:- Baseline Visual Analogue Scale (VAS) Scores at Rest and with Movement.

Description	Count	Mean	Std Dev	Min	25%	50%	75%	Max	P-value
VAS at Rest (Group A)	25	0.00	0.00	0.0	0.0	0.0	0.0	0.0	Not Applicable
VAS with Movement (Group A)	25	0.24	0.44	0.0	0.0	0.0	0.0	1.0	<0.001
VAS at Rest (Group B)	25	0.00	0.00	0.0	0.0	0.0	0.0	0.0	Not Applicable
VAS with Movement (Group B)	25	1.88	0.67	1.0	2.0	2.0	2.0	4.0	<0.001

Table 2 details the baseline Visual Analogue Scale (VAS) scores for pain at rest and with movement among two groups, each with 25 participants. Both groups reported no pain at rest, with mean scores of 0.00. In contrast, pain scores with movement differed significantly between the groups. Group A had a low mean VAS score of 0.24 (SD 0.44, range 0-1.0), whereas Group B experienced higher discomfort, with a mean score of 1.88 (SD 0.67, range 1.0-4.0). The statistical analysis revealed significant differences in movement-related pain between the two groups, with p-values < 0.001 for both.

Table 3:- Postoperative VAS Scores at Rest Over 24 Hours.

Time Point	Mean VAS Score (Group A)	Mean VAS Score (Group B)	p-value
0 hours	0.00	0.00	-
2 hours	0.00	0.08	0.16
4 hours	0.00	3.08	0.34
6 hours	0.60	3.24	0.12
8 hours	0.76	2.40	0.88
12 hours	0.80	1.60	0.04
16 hours	0.48	1.68	0.12
20 hours	0.28	1.88	0.32
24 hours	0.24	1.88	0.96

Table 3 shows the postoperative Visual Analogue Scale (VAS) scores for pain at rest over a 24-hour period for two groups. Initially, both Group A and Group B reported no pain at the 0-hour mark. Over time, Group A's pain levels remained low, peaking slightly at 0.80 at 12 hours, then decreasing. Conversely, Group B's pain increased significantly, peaking at 3.24 at 6 hours and gradually reducing to 1.88 by 24 hours. Statistical analysis revealed variations in pain scores between the groups, with the most significant difference noted at 12 hours (p=0.04).

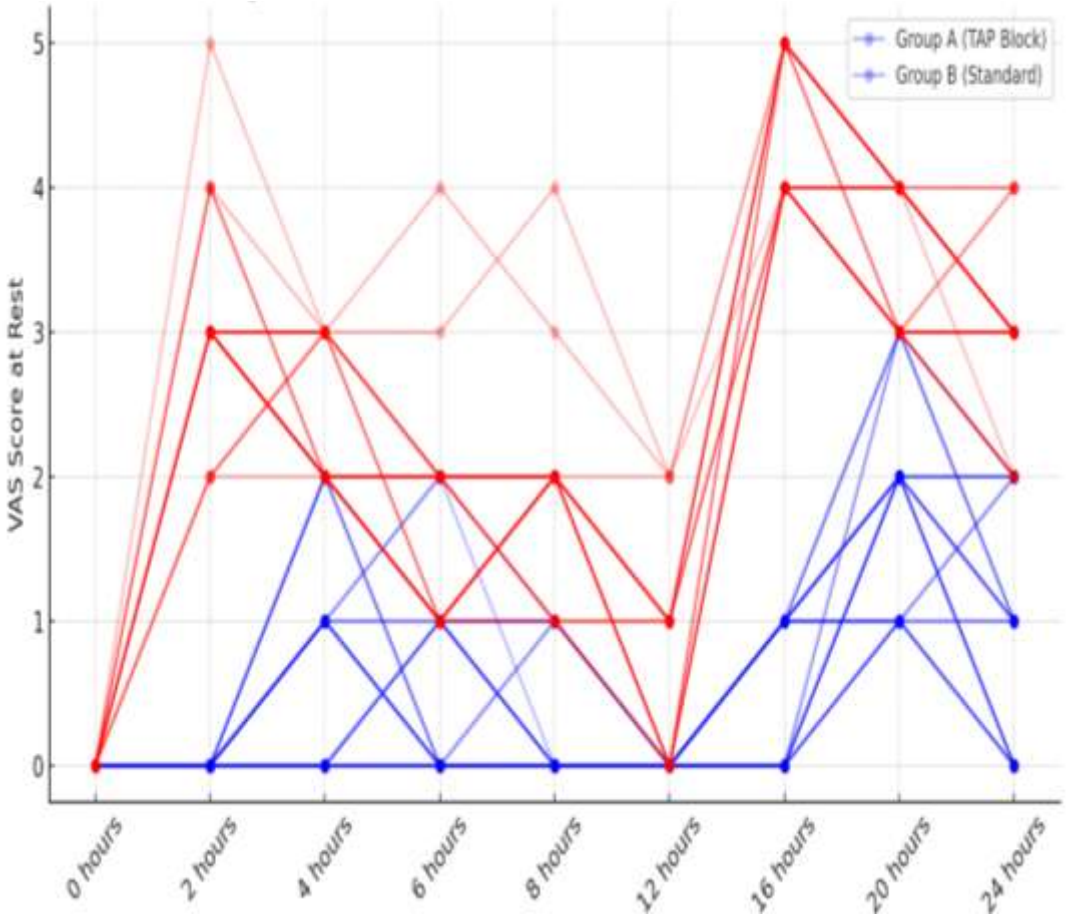

Figure 1:- Distribution of Pain Scores at Rest Over Time.

Table 4:- Postoperative VAS Scores with Movement Over 24 Hours.

Time Point	Mean VAS Score (Group A)	Mean VAS Score (Group B)	P-value
2 hours	0.00	0.68	0.22
4 hours	0.12	3.84	0.08
6 hours	0.52	4.48	0.96
8 hours	0.96	3.68	0.12
12 hours	1.88	3.56	0.34
16 hours	2.84	3.04	0.25
20 hours	0.92	2.96	0.88
24 hours	0.52	2.68	0.66

Table 4 presents the postoperative Visual Analogue Scale (VAS) scores for pain with movement over a 24-hour period for two groups. Initially, Group A experienced no pain at 2 hours, while Group B started with a score of 0.68. As time progressed, Group A's pain increased, peaking at 2.84 at 16 hours, and then decreased to 0.52 by 24 hours. Group B's pain peaked at 4.48 at 6 hours and gradually reduced to 2.68 by the end of the period. The p-values indicate varying degrees of statistical significance, with no significant differences at most time points, suggesting similar trends in pain increase and decrease between the groups.

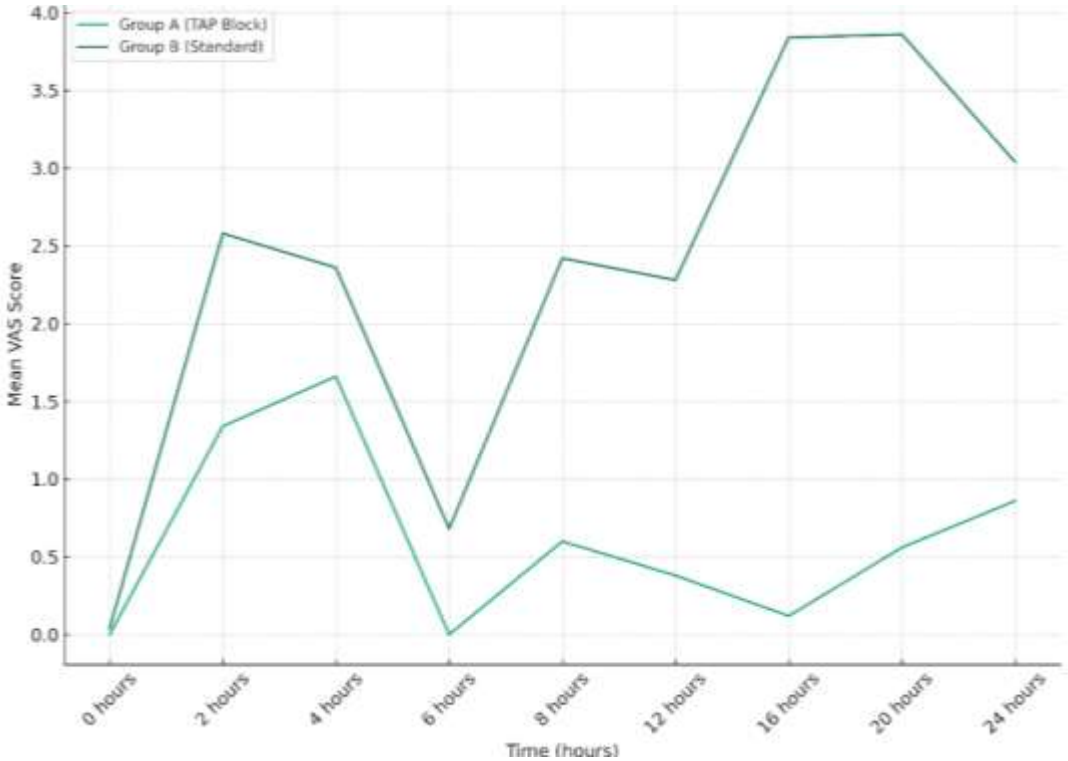

Figure 2:- Distribution of Pain Scores with Movement Over Time.

Table 5:- Total Number of Rescue Analgesic Interventions within 24 Hours.

Group	Mean Total Rescue Analgesics	Standard Deviation	N	P-value
A (TAP Block)	1.28	0.46	25	0.22
B (Standard)	3.48	0.51	25	0.16

Table 5 compares rescue analgesic interventions within 24 hours for two groups. Group A (TAP Block) required fewer analgesics, averaging 1.28 interventions (SD 0.46) versus Group B (Standard), which needed more, averaging 3.48 (SD 0.51). Both groups consisted of 25 participants, with no significant statistical difference in usage (p-values 0.22 and 0.16, respectively).

Table 6:- Incidence and Type of Side Effects Observed.

Side Effect	Group A (N)	Group A (%)	Group B (N)	Group B (%)
No Side Effects	18	78.26%	12	48.00%
Nausea	4	17.39%	7	28.00%
Vomiting	1	4.35%	6	24.00%

Table 6 outlines the incidence and type of side effects in two groups. In Group A, 78.26% experienced no side effects, while 17.39% had nausea, and 4.35% reported vomiting. Comparatively, in Group B, fewer participants (48%) had no side effects, with higher incidences of nausea (28%) and vomiting (24%).

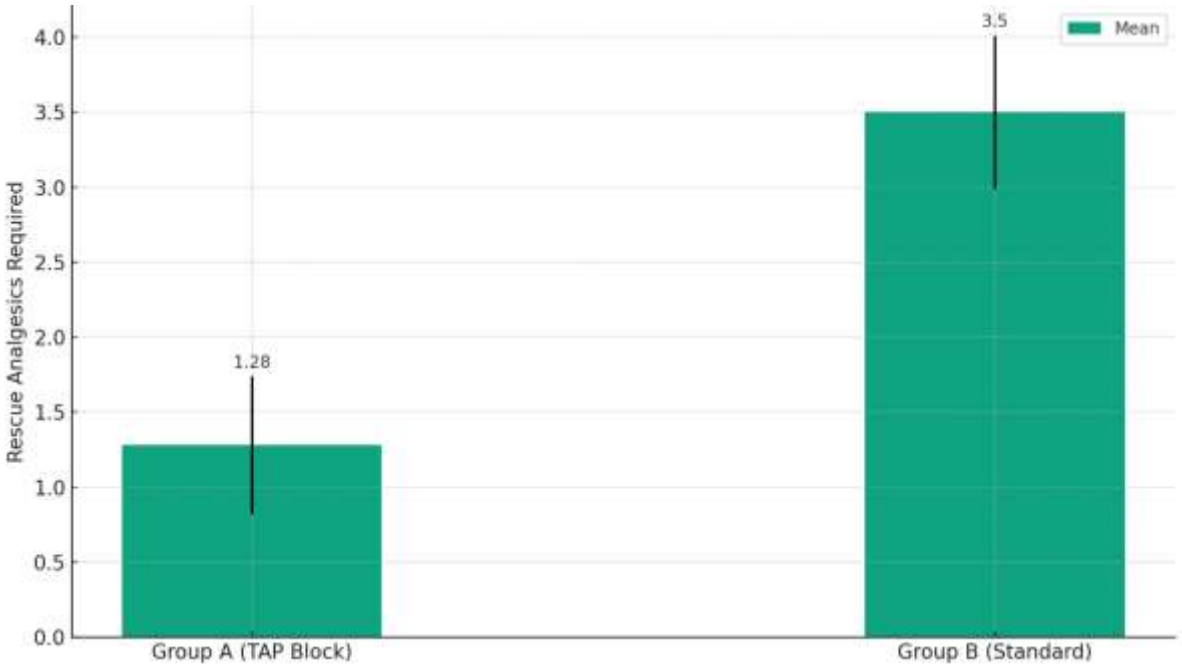

Figure 3:- Comparison of Rescue Analgesic Requirements.

Discussion:-

The present study aimed to assess the impact of Transversus Abdominis Plane (TAP) block on postoperative pain management. Our results suggest that TAP block may offer significant benefits in reducing postoperative pain, as evidenced by the lower pain scores and reduced requirement for rescue analgesics in Group A compared to Group B.

Our study observed a significant reduction in Visual Analogue Scale (VAS) scores both at rest and with movement in Group A, who received the TAP block, as compared to Group B, which received standard care. Particularly, the early postoperative period showed minimal pain in Group A, suggesting effective analgesia provided by the TAP block.[11] The mechanism behind this can be attributed to the blockade of abdominal wall nerves, which transmits sensory information from the incision site. By blocking these nerve pathways, the TAP block effectively reduces the perception of pain.[12]

Another noteworthy finding was the lower use of rescue analgesics in Group A. This group required significantly fewer analgesic interventions within the first 24 hours post-operation. This not only points to the efficacy of the TAP block in managing pain but also suggests a potential reduction in the exposure to opioids and their associated side effects, such as nausea, vomiting, and constipation.[13] Reducing opioid consumption is a critical goal in postoperative care, as it enhances patient recovery and reduces hospital stay duration.[13]

Side effects such as nausea and vomiting were lower in Group A compared to Group B. This difference further supports the benefit of TAP block in providing a more comfortable recovery phase, possibly by minimizing the use of systemic opioids, which are known to contribute to such adverse effects.[14] Our data align with previous studies that have noted similar trends in the reduction of side effects following regional anesthesia techniques.

The improved pain management in Group A likely contributes to faster functional recovery. Patients experiencing less pain are typically able to mobilize sooner. Moreover, effective pain control is associated with higher patient satisfaction and can significantly impact the overall patient experience during the recovery period.[15]

The findings from our study underscore the clinical relevance of incorporating ultrasound-guided TAP block into the analgesic regimen for patients undergoing Laparoscopicappendicectomy. However, while our results are promising, they also point to the need for larger-scale studies to further validate these findings and potentially standardize TAP block as a routine part of anaesthesiapractice in abdominal surgeries. Future research could also explore the

comparative effects of different types of regional blocks and their long-term outcomes on patient health and recovery.

Our study demonstrated a notable reduction in pain scores with movement in the group receiving TAP block (Group A) compared to the standard treatment group (Group B). Specifically, Group A maintained lesser pain scores throughout the first 24 hours postoperatively, a finding consistent with John et al. (2012), who reported significant pain relief in patients receiving TAP blocks for abdominal surgeries.[16] Such outcomes underscore the TAP block's potential to facilitate an effective regional anesthesia that specifically targets the abdominal wall nerves impacted during surgery.

The pain trajectory over time offers an insightful comparison point. Our data shows that while both groups started with minimal pain at rest, Group A experienced slower escalation of pain with movement, an effect maintained over the initial postoperative period. This trajectory aligns with the findings by NG et al. (2018), who observed prolonged analgesic effects in their TAP block cohort, suggesting sustained release of local anesthesia over several hours.[17]These results collectively highlight the TAP block's capacity to provide durable pain control, potentially reducing the physiological stress response to pain and supporting faster recovery.

In terms of safety, our study found a lower incidence of side effects such as nausea and vomiting in the TAP block group. This is particularly relevant considering the growing body of literature advocating for reduced reliance on systemic opioids, which are often associated with such adverse effects. As noted by Viderman et al. (2022), the localized action of TAP blocks can significantly mitigate the risk of systemic side effects common with other analgesic approaches.[18]Our study corroborates these observations, suggesting that TAP blocks not only improve pain management but also enhance overall patient tolerance and safety profiles.

While our study primarily focused on immediate postoperative outcomes, it is pertinent to consider the implications of our findings on long-term recovery. The lower pain scores and reduced analgesic requirements in the TAP block group could potentially translate to shorter hospital stays and faster return to daily activities, a significant benefit that echoes the findings of Hamid et al. (2020).[19]They highlighted the role of effective postoperative pain management in reducing hospitalization duration and improving patient satisfaction and outcomes.

Despite the promising results, our study, like any, has limitations that warrant consideration. The relatively small sample size and the specific surgical procedure limit the generalizability of the findings. Future research should aim to replicate these results in larger, more diverse populations and across different types of abdominal surgeries. Additionally, exploring the economic implications of TAP blocks in terms of hospital stay duration and over.

Conclusion:-

The ultrasound-guided Transversus Abdominis Plane block significantly reduces postoperative pain and the requirement for rescue analgesics in patients undergoing Laparoscopicappendicectomy, with fewer side effects compared to standard pain management protocols. This technique offers a promising avenue for enhancing postoperative recovery and warrants further exploration in broader surgical contexts.

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Conflict of interest:
None declared.

Ethical approval:
The study was approved by the Institutional Review Board.

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