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Comparison of Ultrasound Guided Transversus Abdominis Plane Block versus Local Wound Infiltration for Post Operative Analgesia in Patients Undergoing Inguinal Hernia or Infra Umbilical Incisional Hernia

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ABSTRACT

Background: since the concept of day case surgeries are getting more popular, surgeons and anesthesiologists are trying their best to provide adequate post operative analgesia. The proper management of post operative pain ensures early ambulation of patients and obviates many postoperative complications. **Aim of the Work:** to compare the efficacy of transversus abdominis plane (TAP) block versus wound infiltration with local anesthetic agent as regarding postoperative analgesia, its effect on hemodynamic changes (HR, BP) during rest, opioid (pethidine) consumption. The patients included in this study were either of inguinal hernia or infra umbilical incisional hernia. **Patients and Methods:** after obtaining approval from the medical ethical committee in Ain Shams University, this prospective randomized clinical trial study was conducted in Ain Shams University Hospital. It included fifty adult undergoing inguinal hernia or infra umbilical incisional hernia repair. **Results:** patients were assigned randomly into two equal groups: Group A: (n = 25) TAP Block: patients received general anesthesia followed by Tap block at the end of the operation. Group B: (n=25) Local Wound Infiltration: patients received general anesthesia followed by local wound infiltration at the end of the operation. **Conclusion:** bilateral TAP block was effective in reducing postoperative pain scores at rest and movement for 8-12 hours and lower total 24-h postoperative opioid and analgesic consumption after inguinal hernia or infra umbilical incisional hernia repair under general anesthesia, compared to local wound infiltration. This technique can be a promising mode of postoperative analgesia where epidural catheter insertion is contraindicated.

Keywords: Arterial Blood Pressure - Bronchial Asthma - Central Nervous System

INTRODUCTION

The most common modality for postoperative pain management has remained the parenteral use of non-steroidal anti-inflammatory drugs (NSAIDs) and opioids. The infiltration of surgical wound with long acting local anesthetic agents has also remained a popular method to take care of immediate post operative pain. This technique is virtually cost free, rapid and hardly requires any special technical experience or equipment for its use. But as there are advances in anesthetic techniques, more and more regional blocks are being tried to take care of post operative pain. The choice of anesthetic block technique depends upon the site of surgical incision proposed. Transversus abdominis plane (TAP) block is a novel approach in which local anesthetic agent is injected into the plane between the internal oblique and transverses abdominis muscles [(1)]. This technique was described by ***Kuppuvelumani et al.***[(2)] in 1993 and was formally documented in 2001 by ***Rafi***[(3)]. The technique of TAP block has been found to be a safe and effective tool in a variety of general, gynecological, and urological surgery, and it is suggested as part of the multimodal anesthetic approach to enhance recovery after lower abdominal surgeries [(4)]. Transversus abdominis plane (TAP) block is a regional anesthetic technique which blocks neural afferents from the anterolateral abdominal wall. With the aid of ultrasound or anatomical landmark guidance, local anesthetic is injected into the transverses abdominis fascial plane, where the nerves from T6 to L1 are located. The initial clinical trials assessing the analgesic effect of TAP blockade showed an effect for up to 24 h postoperatively [(5)].

AIM OF THE WORK

To compare the efficacy of transversus abdominis plane (TAP) block versus wound infiltration with local anesthetic agent as regarding postoperative analgesia, its effect on hemodynamic changes (HR, BP) during rest, opioid (pethidine) consumption. The patients included in this study were either of inguinal hernia or infra umbilical incisional hernia.

PATIENTS AND METHODS

After obtaining approval from the medical ethical committee in Ain Shams University, this prospective randomized clinical trial study was

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conducted in Ain Shams University Hospital. It included fifty adult undergoing inguinal hernia or infra umbilical incisional hernia repair. The cases were divided into 2 groups. Group A (n=25) and Group B (n=25). **Inclusion Criteria:** Age 18-60 years. Elective operation under general anesthesia, eight-hour fasting hours. Physical Status: ASA I and II patients after taking written and informed consent. **Exclusion Criteria:** Refusal of procedure or participation in the study by patients. Physical status: ASA III or above. Infection at site of injection. Congenital anomaly of the spine. Psychiatric illness that lead to inability to cooperate, speak or read. Daily use of opioids. Spinal anaesthesia. History or evidence of coagulopathy. Allergies to drugs used (bupivacaine 0.5%). Distorted anatomy. The 50 patients who were scheduled to undergo elective inguinal hernia or infra umbilical incisional hernia repair were randomized using a random number table and the use of a closed envelope technique which was employed to allocate patients between two groups: Group A (TAP Block group). Group B (Local Wound Infiltration group). **Preoperative settings:** Routine preoperative investigations were done to all patients including laboratory investigations as (complete blood picture, bleeding time, prothrombin time and partial thromboplastin time), age, weight, and sex were recorded. The patients were fasting for 8 hours preoperatively. The procedure was done in the operation rooms (OR). The TAP block was performed immediately post-operatively by the anesthesiologist under complete aseptic technique and the surgical wound infiltration was performed subcutaneously by the operating surgeon immediately after the end of the surgery. **Intraoperative Setting: Monitoring:** Basic monitoring; including electrocardiogram (ECG), pulse-oximetry (SpO_2) and non-invasive blood pressure (NIBP), were applied to all patients, starting before anesthesia till end of surgery and then recovery. Intraoperative hemodynamic measurements for all patients in the two groups included heart rate, systolic and diastolic arterial blood pressure, SpO_2 and ET CO_2. Postoperative hemodynamic measurements included heart rate and systolic and diastolic arterial blood pressure for all patients in the two groups as well. **Anesthetic Techniques:** General Anesthesia Technique: Inside the operating room, intravenous access was obtained, monitor was connected and baseline non-invasive blood pressure (NBP), heart rate (HR), electrocardiography (ECG) and pulse oximetry (SpO_2) were obtained. **Induction** after pre-oxygenation for 3 minutes, general anesthesia was induced to all patients Midazolam 0.02 mg/kg, thiopental 5 mg/kg and fentanyl 1μg/ kg was used for analgesia. The intubation was done with standard size endotracheal tube (suitable for the patient) after relaxation provided by, atracurium 0.5 mg/kg IV**. Maintenance** of anesthesia was obtained using intermittent positive pressure ventilation with inhalation of 1-1.2% Isoflurane in 50% O_2/air, and atracurium (0.1 mg/Kg every 20 minutes IV) to maintain muscle relaxation. Intraoperative monitoring of ECG, HR, NIBP, SpO_2, and capnograph were continued throughout the operation. **At the end of surgery:** Bilateral TAP block was done with 20 ml of 0.25% bupivacaine on each side by midaxillary approach under ultrasound guidance with position, under aseptic conditions, the probe was placed transversely between the iliac crest and costal margin. Echogenic spinal needle, 22G, 8 cm, was advanced in-plane. After visualization of the tip of the needle reaching the plane, 2 ml of anesthetic solution was instilled to view the hydro dissection, confirming the correct placement. Following this, the total volume of drug was instilled, creating a meniscus between the planes. Local wound infiltration was done with 0.25% bupivacaine 20 ml at the end of operation. **Recovery:** At the end of surgery, the residual neuromuscular block was reversed with injection neostigmine 0.05 mg/kg and atropine 0.01mg /kg, awake extubation, in a semi-sitting position, was done when the patient can follow verbal commands, sustain head lift or hand grasp for 5 seconds, and achieve tidal volume of more than 6 ml/kg and respiratory rate of less than 35 breaths/min, with stable hemodynamics. Then, the patient was transferred to the PACU. Visual analogue score (VAS), 1-10 was recorded at 1, 2, 4, 6, 12, 18 and 24 hours during rest, HR, BP were monitored at the time interval. Patients with VAS score or > 4 at any point of time, received pethidine 1 mg/kg intramuscularly.

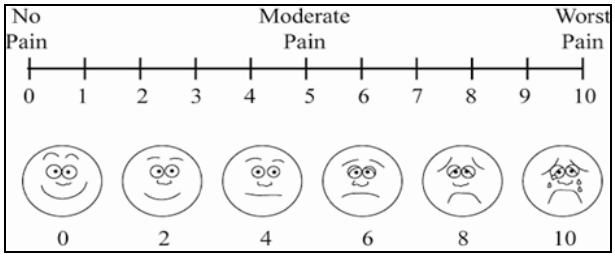

Fig. (1): Visual Analog Scale (VAS) [6].

Statistical analysis: Recorded data were analyzed using the statistical package for social sciences, version 20.0 (SPSS Inc, Chicago, Illinois, USA). Quantitative data were expressed as mean± standard deviation (SD). Qualitative data were expressed as frequency and percentage. **The following tests were done:** Independent-samples t-test of significance was used when comparing between two means. Mann Whitney U test: for two-group comparisons in non-parametric data. Chi-square (x2) test of significance was used in order to compare proportions between two qualitative parameters. The confidence interval was set to 95% and the margin of error accepted was set to 5%. So, the p-value was considered significant as the following: Probability (P-value): P-value <0.05 was considered significant. P-value <0.001 was considered as highly significant. P-value >0.05 was considered insignificant. The two groups were comparable according to the demographic data in terms of age, sex, ASA class I-II, anaesthesia duration and duration of the surgery in minutes.

RESULTS

Table (1): Comparison between two groups according to demographic data

Demographic Data	Group A: TAP (N=25)	Group B: L Wound (N=25)	p-value
Age (years) Range Mean±SD	 18-60 41.96±12.96	 18-60 42.17±11.78	>0.05
BMI [(wt/(ht)^2] Range Mean±SD	 21-32 27.31±5.37	 20-31 27.02±5.96	>0.05
ASA grade I II	 15 (60%) 10 (40%)	 14 (56%) 11 (44%)	>0.05

p-value >0.05 NS

This table shows no statistically significant difference between groups regarding demographic data.

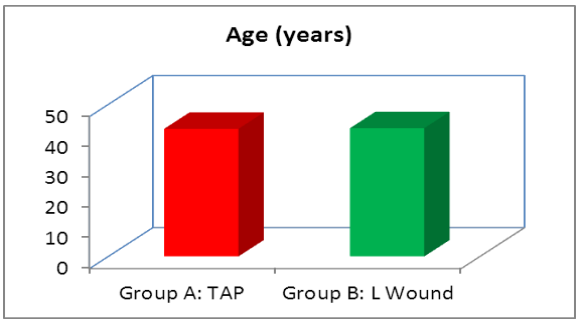

Fig. (2): Graph comparison between two groups according to age (years).

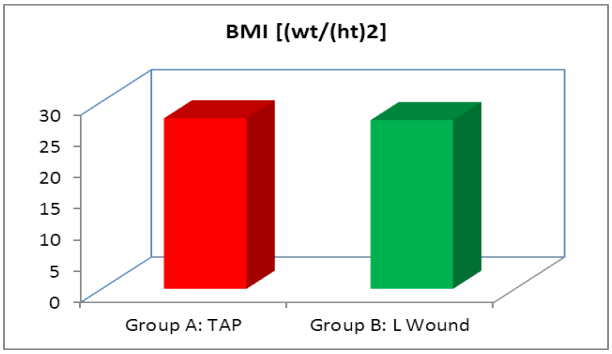

Fig. (3): Graph comparison between two groups according to BMI.

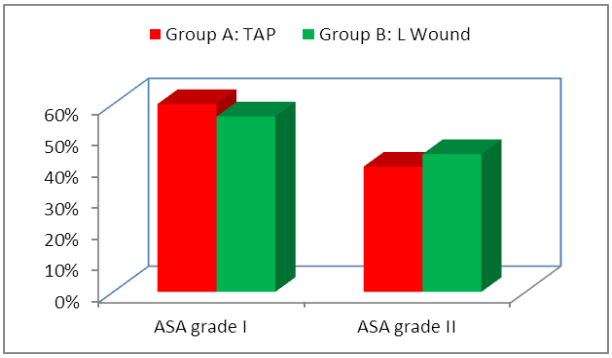

Fig. (4): Graph comparison between two groups according to ASA.

Heart Rate (beats/min): Heart rates compared between the two studied groups are shown in ***(table 2)***. There was significant difference between groups as regarding heart rate [HR] at time 12 hrs to 24 hrs, monitored in beats per minute at fixed times interval post-operatively, where P value > 0.05.

Table (2): Comparison between two groups as regards heart rate at rest

Heart Rate	Group A: TAP (N=25)	Group B: L Wound (N=25)	p-value
1 hr	71.4±6.0	71.4±6.0	>0.05
2 hrs	71.4±6.0	71.4±6.0	>0.05
4 hrs	71.4±6.0	76.5±6.4	>0.05
6 hrs	71.4±6.0	76.5±6.4	>0.05
12 hrs	76.5±6.4	86.7±7.2	0.041*
18 hrs	76.5±6.4	91.8±7.7	<0.001**
24 hrs	76.5±6.4	91.8±7.7	<0.001**

p-value >0.05 NS, **p-value <0.001 HS

This table shows no statistically significant difference between two groups at time 1-6 hrs post operatively and statistically significant difference between two groups according to heart rate from 12 hrs, where p-value <0.05, and highly significant at time 18,24hrs where P value <0.001, at Rest.

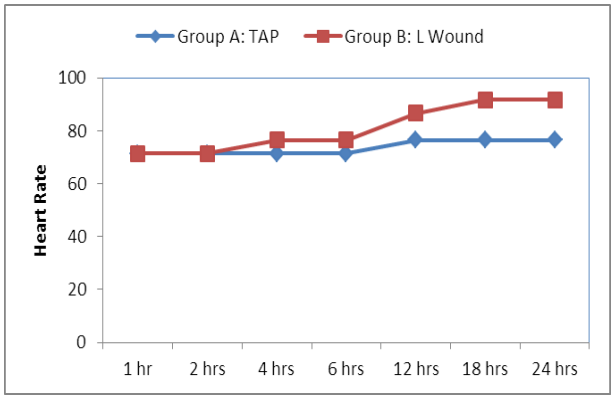

Fig. (5): Graph shows comparison between two groups according to heart rate at rest.

Arterial Blood Pressure (ABP): Arterial blood pressure (systolic and diastolic) were compared between the studied groups and shown in (table 3 and 4). There was no statistically significant difference between the studied groups regarding ABP, with P values more than 0.05.

Table (3): Comparison between two groups according to systolic blood pressure at rest

Systolic Blood Pressure	Group A: TAP (N=25)	Group B: L Wound (N=25)	p-value
1 hr	112.2±9.4	113.2±9.4	>0.05
2 hrs	117.3±9.8	114.2±9.5	
4 hrs	113.2±9.4	116.3±9.7	
6 hrs	114.2±9.5	118.3±9.9	
12 hrs	116.3±9.7	120.4±10.0	
18 hrs	122.4±10.2	124.4±10.4	
24 hrs	122.4±10.2	125.5±10.5	

p-value >0.05 NS

This table shows no statistically significant difference between groups according to systolic blood pressure at rest, where p-value >0.05.

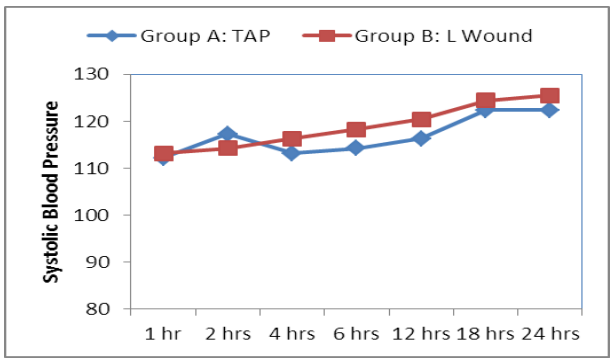

Fig. (6): Graph shows comparison between two groups according to systolic blood pressure at rest.

Table (4): Comparison between groups according to diastolic blood pressure at rest

Diastolic Blood Pressure	Group A: TAP (N=25)	Group B: L Wound (N=25)	p-value
1 hr	71.4±6.0	71.4±6.0	>0.05*
2 hrs	73.4±6.1	72.4±6.0	
4 hrs	80.6±6.7	83.6±7.0	
6 hrs	81.1±6.8	84.7±7.1	
12 hrs	81.6±6.8	85.7±7.1	
18 hrs	83.6±7.0	86.7±7.2	
24 hrs	85.7±7.1	87.7±7.3	

p-value >0.05 NS, <0.05 S

This table shows no statistically significant difference between groups according to diastolic blood pressure at rest, where p-value >0.05.

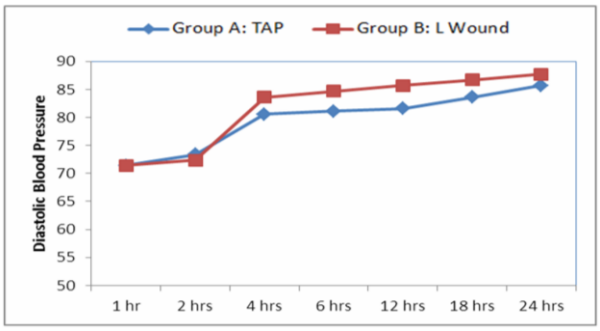

Fig. (7): Graph shows comparison between two groups according to diastolic blood pressure at rest.

Assessment of pain: Pain score was compared between the two studied groups using the visual analogue scale (VAS) and the results are displayed in ***(tables 5)***. There was statistically significant difference between the studied groups regarding VAS at 6 hrs post operatively And, highly significant difference was observed in pain score (VAS) measured at 12hrs postoperatively, being much higher among group B patients with P value less than 0.001.

Table (5): Comparison between two groups according to VAS at rest

VAS	Group A: TAP (N=25)	Group B: L Wound (N=25)	p-value
1 hr	1 (0)	2 (1)	>0.05
2 hrs	1 (0)	2 (1)	>0.05
4 hrs	1 (1)	2 (1)	>0.05
6 hrs	2 (1)	4 (2)	0.025*
12 hrs	4 (2)	8 (2)	<0.001**
18 hrs	6 (2)	8 (2)	0.022*
24 hrs	6 (2)	8 (2)	0.017*

z-Mann-Whitney test; p-value >0.05 NS; *p-value <0.05 S; **p-value <0.001 HS

This table shows no statistically significant difference between two groups according to VAS at time 1-4 hrs post operatively, statistically significant difference between two groups according to VAS at 6hrs ,18hrs and 24 hrs, where p-value <0.05, and highly significant at time 12hrs where P value < 0.001 at Rest.

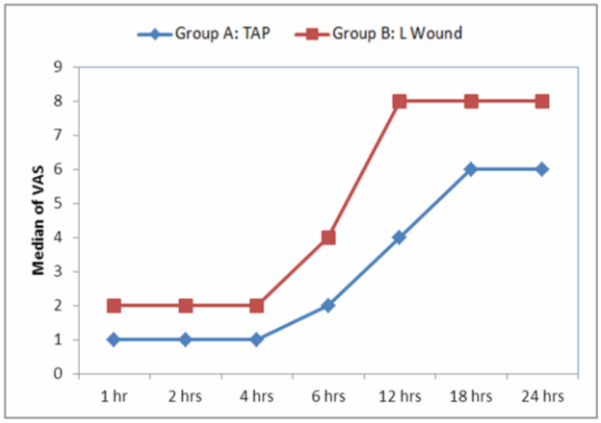

Fig. (8): Graph shows comparison between two groups according to VAS at Rest.

Rescue Analgesia: Rescue opioid analgesia was compared between the studied groups regarding the time of first dose needed, total dose required in 24 hours and number of patients need analgesic are shown in ***(table 6)***. There was a highly significant delay in the time of requirement of rescue analgesia among group A patients *(who received TAP block)* far beyond those of group B *(who received local wound infiltration).*

Table (6): Comparison between two groups according to rescue analgesia (pethidine 1mg/kg) at rest

Analgesic (0.75 mg)	Group A: TAP (N=25)	Group B: L Wound (N=25)	p-value
1 hr	0 (0%)	0 (0%)	1.000
2 hrs	0 (0%)	0 (0%)	1.000
4 hrs	0 (0%)	0 (0%)	1.000
6 hrs	0 (0%)	0 (0%)	1.000
12 hrs	0 (0%)	25 (100%)	<0.001*
18 hrs	20 (80%)	25 (100%)	>0.05
24 hrs	20 (80%)	25 (100%)	>0.05

p-value >0.05 NS; *p-value <0.001 HS

This table shows statistically significant difference between groups according to analgesic at 12 hrs at rest, where p-value <0.001.

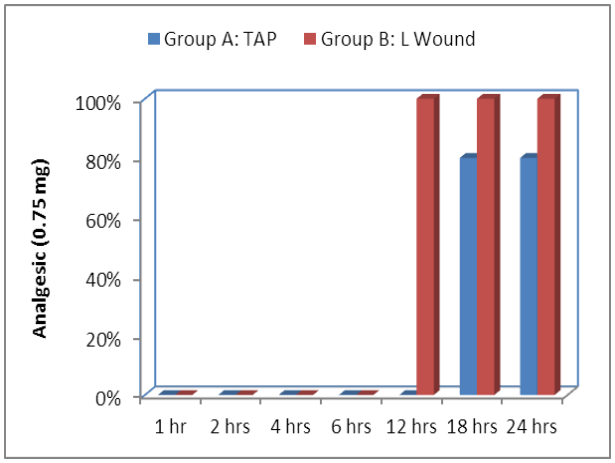

Fig. (9): Graph comparison between two groups according to analgesic (pethidine 1mg/kg) at Rest.

DISCUSSION

Inguinal hernia considered the third common disease in surgeries for adult after acute appendicitis and proctologic disorder. About 20 millions of inguinal hernia repairs are performed globally. Inguinal herniorrhaphy is frequently associated with persistent postoperative pain [(7)]. A significant proportion of pain experienced by patients undergoing abdominal surgeries is related to somatic pain signals derived from the abdominal wall [(8)]. The anterior abdominal wall components are supplied by sensory neurons derived from the anterior rami of spinal nerves T6 to L1, which include intercostal nerves T6 to T11, subcostal nerve T12 and ilioinguinal and iliohypogastric nerves L1. These neurons traverse through the neurofascial plane between the internal oblique and the transversus abdominis muscles [(9)]. A variety of unwanted post operative consequences following poorly controlled pain after abdominal surgery includes prolonged hospital stay besides patient suffering and distress, respiratory complications, delirium, myocardial ischemia, prolonged hospital stay and an increased likelihood of chronic pain. Transversus abdominis plane (TAP) block, first described by ***Kuppuvelumani et al.*** [(2)], and formally documented by ***Rafi*** [(3)], is used for the management of post operative abdominal pain [(10)]. The benefits of good postoperative analgesia include a reduction in the postoperative stress response and morbidity, better patient satisfaction and improved outcome [(11)]. Although thoracic epidural analgesia has been considered the gold standard in providing pain relief after lower

abdominal surgery on the lower abdominal wall, associated complications and contraindications may limit its use. Intravenous opioid analgesia may cause opioid-related side effects and could be associated with inadequate analgesia. Alternative approaches to traditional anesthetic techniques should be investigated. Subcostal Transversus abdominis plane (TAP) block by injecting local anesthesia into the plane between the internal oblique and transversus abdominis muscle has been reported to provide analgesia for incisions extending above the umbilicus [(12)]**.** The advantages of TAP block include simple and effective analgesic technique, appropriate for surgical procedures where parietal peritoneum is a significant component of postoperative pain, very minimal complication rate and can be performed even if neuraxial techniques are contraindicated. In surgeries where TAP block alone may not be adequate, it may be used as part of a multimodal pain regimen [(13)]**.** To enhance the recovery after lower abdominal surgeries, Ultrasound guided transversus abdominis plane block provides excellent results in experienced hands with lesser complications. TAP block is both effective and safe post operative analgesic modality in a variety of procedures including general surgeries and decreases opioid (pethidine) consumption after lower abdominal. Wound infiltration with local anesthetic agent is also a commonly used method for reducing post operative pain. A single injection of local anesthesia into skin and subcutaneous tissue layer at surgical incision sites could lower the pain scores postoperatively. It is a convenient post operative analgesia procedure which is widely performed [(14)]**.** VAS pain score, considered the gold standard of pain quantification, was used to evaluate the severity of postoperative pain at rest and during cough. The present study found that there was a significantly lower pain score in the TAP group at 12 h postoperatively compared with the wound infiltration group. Total morphine consumption was less in the TAP group. The number of patients who required supplemental morphine was less in TAP block. Time to first analgesic request was longer in the TAP group. This randomized trial aimed to determine the postoperative analgesic efficacy of transversus abdominis plane (TAP) block compared to local wound infiltration for the patients undergoing inguinal hernia or infra umbilical incisional hernia repair regarding the pain relief and the amount of opioid and analgesic used. This study measured and compared postoperative hemodynamics in the first 24 hours which were represented as arterial blood pressure and heart rate with the standard deviation for each respectively among the two studied groups and showed that patient received TAP block group had almost the same values of arterial blood pressure in comparison to the local wound infiltration group at 1, 2, 4, 6, 12, 18 hours and 24 hours postoperative, with significant value in heart rate, first analgesic dose needed after 12 hrs. Our results met the conclusion of ***Sivapurapu et al.*** [(15)], who compared the analgesic efficacy of TAP block with that of direct infiltration of local anesthetic into surgical incision in lower abdominal gynecological procedures under general anesthesia. Time to rescue analgesic was significantly longer and the VAS scores were lower in the TAP group. The 24 h morphine requirement and the incidence of side effects were less in the TAP group. In a meta-analysis conducted by ***Mishriky et al.*** [(16)], they reported that TAP block significantly reduced opioid consumption and reduced pain scores for upto 12 h postoperatively, in a prospective, randomized, double-blind study of 64 patients undergoing inguinal hernia repair, found that TAP block provided effective analgesia, reducing total 24-h postoperative analgesic consumption and morphine requirement ***(Salman et al., 2013)*** [(17)]**.** The study done by ***Peterson et al. (2013),*** [(25)] In patients who underwent inguinal hernia repair, applied postoperative TAP block under USG in one group and assured the surgeon to perform both blind local anesthetic infiltration and ilioinguinal nerve block in another group. They compared both groups to a placebo group. They suggested that VAS values are significantly higher in the TAP block group than in the infiltration group, but they were not different from the placebo group. Furthermore, the dose of paracetamol and ibuprofen given to the placebo group regardless of the presence of pain is considerably high for postoperative pain treatment after inguinal hernia surgery, and it removes the need for additional intervention. Moreover the cardiovascular protective effect of TAP block was reported by ***O'Donnell et al.*** [(18)] when used as an analgesic technique modality in open retro-pubic prostatectomy. It reduced the incidence and severity of sedation together with reduction in the

postoperative pain scores (VAS at rest and knee flexion), which maintained the cardiovascular stability. None of the patients among the TAP group asked for postoperative rescue analgesia. The study done by ***Niraj et al.*** [12] found that pain after surgery for acute appendicitis was powerfully controlled among patients who received the TAP block. There were significant reduction in the pain scores in comparison to standard use of systemic morphine as a recue analgesia. The pain control effect of TAP block in this study was supported by the reduction in the total consumption of morphine among TAP block group. On the other hand, the study done by ***Niraj et al.*** [12] who compared the analgesic efficacy of subcostal TAP block and epidural analgesia following upper abdominal surgery and found that there was no significant advantage of epidural analgesia over subcostal TAP catheter bolus analgesia. Also, ***Dolin et al.*** [19] compared the transversus abdominis plane block with liposomal bupivacaine versus continuous epidural analgesia versus intravenous opioid analgesia and found that the TAP block with liposomal bupivacaine and epidural technique did not differ in pain and opioid consumption and not worse in pain scores as compared with intravenous patient controlled analgesia technique after abdominal surgery. Subcostal TAP catheters may have advantages when compared with these two techniques. There have been few reported complications reported following TAP blocks and they provide both static and dynamic analgesia. ***Sharma et al.*** [20] evaluated the analgesic efficacy of TAP block in comparison to patient controlled tramadol analgesia after abdominal surgery. They found that the TAP block provided highly effective postoperative analgesia and reduced VAS pain scores in the first 24 postoperative hours after major abdominal surgery, and no complications due to the TAP block were detected. **Tammam** [21] performed a study in ***(2013)*** on TAP block for inguinal hernia through a catheter placed by ultrasound-guided Seldinger catheter insertion approach. The mean cumulative morphine requirement over the first 48 hours postoperative period was significantly less in the block group. In spite of the presence of the catheter, our study has examined only a single dose of 20 mL 0.375% bupivacaine with which they could demonstrate reduced analgesic requirement for 24 hours. ***Niraj et al.*** [26] shows that continuous TAP analgesia can provide effective dynamic analgesia after laparoscopic colorectal surgery. When compared with epidural analgesia, continuous TAP analgesia does not cause hemodynamic imbalance, preserves motor function of the lower limbs and can be used in patients requiring anticoagulation medication. ***Gupta et al.*** [22] performed a randomized trial on ultrasound-guided TAP block versus continuous wound infusion for post cesarean section analgesia. The postoperative analgesia was randomized to either a bilateral TAP block or a continuous wound infusion. The study was prematurely terminated due to the occurrence of generalized seizures in one patient within the TAP group. This may have been because of the higher dose in a parturient or an accidental intravascular injection. ***Rao et al.*** [23] studied the analgesic efficacy of continuous epidural analgesia with continuous TAP block for major abdominal surgery. The authors found no differences in regard to pain scores at any point or over time, postoperative fentanyl requirement, and patient satisfaction. In another study done by **Kandi** [24]**,** evaluating the efficacy of ultrasound-guided TAP block versus epidural analgesia in pain management following lower abdominal surgery, the author has reported that TAP block provided highly effective postoperative analgesia in the first 24 h with longer analgesic free periods in the TAP group compared to the epidural group during the first 24 h postsurgery. There was also a significant reduction in the number of cases needing more than 200 µg/kg of morphine in the TAP group when compared to the epidural group.

CONCLUSION

Bilateral TAP block was effective in reducing postoperative pain scores at rest and movement for 8-12 hours and lower total 24-h postoperative opioid and analgesic consumption after inguinal hernia or infra umbilical incisional hernia repair under general anesthesia, compared to local wound infiltration. This technique can be a promising mode of postoperative analgesia where epidural catheter insertion is contraindicated. Use of adjuncts or use of continuous catheters might be used for prolonging the duration of the block.

CONFLICTS OF INTEREST

There are no conflicts of interest.

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