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A comparative study of ultrasound guided dual TAP block versus intraperitoneal instillation and periportal infiltration of ropivacaine with dexamethasone for postoperative analgesia in laparoscopic cholecystectomy

Dr Aleesha Gupta[1], Dr Rajesh Angral[2], Dr Anshuman Mahesh Chander[3]

1Assistant Professor, Department of Anesthesiology,GMC, Kathu,J&K.
2Associate Professor, Department of Anaesthesia GMC Kathua, J&K.
3Associate Professor, Department of surgery, GMC Kathua, J&K.

Corresponding author:
Dr Rajesh Angral
Associate Professor Department of Anaesthesia GMC Kathua, J&K.
Email - rajeshangral73@gmail.com

Abstract-

Introduction- Laparoscopic cholecystectomy (LC) being the minimal invasive procedure has replaced open surgery over the time. However discomfort after LC due to pain is a vital issue. So in our study we have compared efficacy of ultrasound (US) guided dual transversus abdominis plane (TAP) block with intraperitoneal instillation and periportal infiltration of local anathesia (LA) after LC. **Material and methods-** 100 patients planned for LC at Government medical college (GMC) Kathua, Jammu and Kashmir (J&K) were enrolled in the study and were randomly divided into two groups each having 50 patients. Group-I received US guided dual TAP block and group-II received "intraperitoneal instillation and periportal infiltration" of roipivavcaine with dexamethasone. To compare the pain experienced by both the groups, VAS visual analogue scale score (VAS) was assessed and patient satisfaction with pain control was assessed using "Global Satisfaction Score"(GSS). "P-value ≤0.05 was considered significant". **Result-** First request for rescue analgesia by group-II was significantly late than group I and significantly lower number of patients in group-II required second dose of rescue analgesia. VAS score was reported to be significantly lesser by group-II compared to group-I at 1,2,4,8 & 10hr. GSS also indicated group-II patients to be more satisfied with pain control. **Conclusion-** Our study suggests combined "intraperitoneal instillation and periportal infiltration" to be a promising approach for postoperative analgesia after LC as patients experienced less pain, late

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demand for first rescue analgesia, required less postoperative analgesia and showed more satisfaction with pain control.

Keywords- LC, TAP block, intraperitoneal instillation, periportal infiltration, LA, VAS etc.

Introduction-

Gallbladder illness needing its removal was previously managed by open surgery. However, laparoscopic cholecystectomy (LC) being the minimal invasive procedure has replaced open surgery over the time and is considered as gold standard technique for gallbladder issues.[1,2] LC is the widespread endoscopic surgical intervention with fast recovery and less postoperative pain. Although intensity of pain after LC is less than open surgery but in the initial 24 hours after surgery, 35 to 63 % patients often experience significant pain along with other complications and the intensity may vary from moderate-to-severe. Nevertheless discomfort after LC due to pain is a vital issue and has been managed by many suitable approach like parentral pharmacological agents (NSAIDS and opioids) , local anesthetic (LA) infiltration and various block interventions.[3-5]. The root cause of pain after LC is referred, incisional or visceral. The rate and grade of incisional pain is more after LC. So the approaches being used for pain management now focus on lowering incisional pain. One of the effective approaches being used these days is "transversus abdominis plane (TAP) block", by which abdominal neural afferents are inhibited by giving local anesthesia (LA) into neurofascial plane between the "transversus abdominis" and "internal oblique muscles". TAP block is safe and has limited side effects with low demand of analgesics.[6] Moreover by means of ultrasound (US) guidance, clinicians are further dynamically focusing on accurate localization of TAP. However, many randomized controlled studies have documented different results[7] leading to a debate regarding area of administration and numeral of block. As there was no clarity concerning the efficacy of type of TAP block technique[8] so in our study we have given US guided dual TAP block to LC patients.

The other technique reported to be effective and part of post operative analgesia in many abdominal surgeries is periportal infiltration and peritoneal instillation of LA. The ground of this approach is the block of visceral nociceptive conduction exposed to peritoneum and also by absorption LA from huge peritoneal surface. In our study instead of focusing on one of them, we have taken a joint approach using intraperitoneal and peri-portal infiltration of LA for somato-visceral blockade to compete with US guided dual TAP block technique. A variety of LA agents like levobupivacaine, bupivacaine and ropivacaine, are favored for post-operative pain

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management with TAP block and other approaches.[9] Ropivacaine and bupivacaine show comparable plasma protein binding property and pKa value but ropivacaine, has less cardiac and systemic toxicity. So in our study we have used ropivacaine as LA agent. To enhance the analgesic efficacy of LA agents, they are usually combined with several adjutants like dexmedetomidine, clonidine, epinephrine, and dexamethasone.[10,11] As only few studies are carried on using these adjutants[12-14] so in our study we have combined dexmethasone along with ropivacaine. To the best of our knowledge there is hardly any study comparing these two techniques of post operative analgesia in LC. So the present research aimed to see efficiency of US guided dual "TAP block" technique versus intraperitoneal instillation and peri-portal infiltration of ropivacaine with dexamethasone for post operative analgesia in LC.

Material and method-

Present study was a prospective, randomized, double blinded comparative study conducted in the department of anaesthesiology, Government Medical College (GMC) Kathua, Jammu, Jammu and Kashmir (J&K) from January 2022 to April 2023, after taking approval from institutional ethical committee. A total of 100 patients in the age group of 18 to 60 years, with gall bladder illness planned for LC with "American Society of Anesthesiologists (ASA)" physical status I and II and of both sex were included in the study. The consent was taken from all the subjects fulfilling inclusion criteria. The patients having any allergy to LA, having coagulopathies, heart, kidney or liver abnormality or who were not interested to participate were excluded from the study. In preoperative room, the participants were given instructions regarding the use of VAS (visual analogue scale). All the other preoperative instructions and medication given to the patients were according to the protocol followed by the hospital. The Standard method for general anaesthesia (GA), intra-operative procedure like tracheal intubation, surgery, monitoring of vitals etc. for all the patients was done according to hospital protocol. At the last of procedure, before extubation , the participants were assigned randomly to any of the groups with 50 patient each i.e. group-I or group-II.

- Group-I : received US guided dual TAP block with 50 ml of ropivacaine .25% (48 ml) plus 2ml of dexamethasone(8mgs). Patients were positioned in supine posture. The anesthesiologist placed the US probe (6-13 MHZ) obliquely on the upper abdominal wall along the subcoastal margin near the xiphisternum in the midline of abdomen. The

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landmarks which included the rectus abdominis muscle and underlying transverse abdominis muscle were identified near the coastal margin and xiphoid. The probe was then moved laterally until the aponeurosis of abdominis muscle was seen and then the probe was moved further laterally until the transverse abdominis muscle was identified. The anestheologist directed the needle towards the transverse abdominis fascia and injected 10ml of solution on each subcostal side (20ml). To conduct posterior TAP, the anesthesiologist cautiously moved the US probe posteriolaterally after placing it on the iliac crest and the costal border on the mid axillary line of abdominal wall. A 80mm 21G spinal needle was placed in plane at a $30\text{-}40^0$ angle, moving from medial to lateral under all aseptic precautions. The exact needle tip location was checked by hydrodissection with 2-3ml of isotonic saline before the anesthetist administered 15 ml of solution on each sides (30 ml).

- Group-II : received intraperitoneal instillation and periportal infiltration of 50 ml of ropivacaine .25% (48 ml) plus 2ml of dexamethasone(8mgs). 30 ml of solution was injected into hepato-diaphragmatic space, over hepato-duodenal ligament and over gall bladder fossa under the direct vision before removal of ports at the end of operation. 20ml of the solution was infiltrated at all the 4 port sites.

Randomization and group allocation was placed in the closed opaque envelopes with numbers. The concerned anesthesiologist was not further involved in post-operative care. The investigator, surgeon, patient and nursing staff were blinded to the research medications and were not aware about the group assignment. In post operative unit, the standard hospital protocol was followed. For breakthrough pain VAS score for pain was recorded serially at 1,2,4,6,8,10,12,14,16 and 24 hour after surgery in which a "10-cm vertical score ranges from 0= no pain to 10= worst pain imaginable". Rescue analgesia was given when VAS score was >4 or when the patient experienced pain. The time and VAS score at the moment of first analgesic request were noted. The period of analgesia was considered as the time from LA administration by any of the two approaches till the point at which patient experienced pain or VAS score >4 on evaluation at serial intervals. Total consumption of rescue analgesic dose in the first 24 hours and the set of patients experiencing post-operative complications like bleeding, nausea, vomiting etc. were also noted. The Global Satisfaction Score (GSS) which is used to assess patient's satisfaction with pain control was also evaluated within 48 hours as follows: "poor =1", "fair =2", "good =3", or

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"very good =4". The data were noted and evaluated using "SPSS (statistical package for social sciences) version 27". "A P-value < 0.05 was considered to be statistically significant".

Result-

Overall 100 participants were enrolled in the research and were assigned randomly into two groups each having 50 subjects. Group-I received US guided dual TAP block and group-II received intraperitoneal instillation and periportal infiltration of roipivavcaine with dexamethasone.There was no significant difference with respect to age, sex, ASA grade ,weight and height of the patients in both the groups (Table-1).

Table 1- Comparision of demographic variables in both the study groups.

Parameter		Group-I (n=50)	Group-II (n=50)	p-value
Age (years)		44.02 ± 5.83	44.98 ± 3.92	0.336
Sex n (%)	Males	31 (62.0%)	34 (68.0%)	0.374
	Females	19 (38.0%)	16 (32.0%)	
ASA Physical status n (%)	I	32 (64.0%)	26 (52.0%)	0.223
	II	11 (22.0%)	14 (28.0%)	
	III	7 (14.0%)	10 (20.0%)	
Weight (mean in kg)		66.88 ± 7.87	68.74 ± 4.77	0.157
Height (mean in m)		1.71 ± 0.09	1.68 ± 0.12	0.083

As visible from Table 2, 50% group-I patients needed rescue analgesia in first 8hrs i.e. at 6hr-10 (20.0%) and at 8hr-15(30.0%) than group-II with 0(0%). Rest 50% of group-I patients had rescue analgesia at10hr i.e. 25 (50.0%) with 0(0%) at other time intervals. Group-II patients demanded first rescue analgesic at 10hr with 10(20.0%), then at 12 and 14hr with 15(30.0%) and lastly at 16 and 24hr with 5(10.0%). The association of distribution of patients according to time for first rescue analgesic was observed to be significant with type of LA approach. The mean of time to first rescue analgesic was significantly higher in group-II (14.0±3.16hr) than group-I (8.0±2.0hr).

Table 2- Comparision of first rescue analgesic dose requirement time in both the study groups.

Time for first rescue Analgesics	Number of patients (%)		p-value
	Group-I (n=50)	Group-II (n=50)	

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6hr	10(20.0%)	0(0.0%)	
8hr	15(30.0%)	0(0.0%)	
10hr	25(50.0%)	10(20.0%)	**<0.0001**
12hr	0(0.0%)	15(30.0%)	
14hr	0(0.0%)	15(30.0%)	
16hr	0(0.0%)	5(10.0%)	
24hr	0(0.0%)	5(10.0%)	
Mean±SD (hr)	8.0±2.0	14.0±3.16	**0.031**

Figure 2 clearly shows that no patient from group-II needed 2nd dose of rescue analgesia. 35(70.0%) of group-I patients had first dose of rescue analgesia and rest 35(70.0%) demanded 2nd rescue analgesia dose. The association of requirement of rescue analgesia dose with type of LA approach was significant.

Table 3 shows VAS score of both the groups. The mean "VAS score" of group-I at 1,2,4,6,8,10,12,14,16 & 24hour was observed as 1.36±0.75, 1.64±0.48, 1.76±0.48, 2.32±1.06 2.80±1.09, 3.16±1.22, 2.10±0.61, 2.14±0.64, 1.60±0.49 & 1.38±0.60 consecutively. Group-II reported lower mean VAS score for initial 10hrs than group-I as 1.06±0.59, 1.34±0.52, 1.52±0.50, 2.06±0.24, 2.02 ±0.32, 2.40±0.86, 2.36±1.16, 2.16±1.25, 1.70±0.95 & 1.40±1.11 at 1,2,4,6,8,10,12,14,16 and 24 hours respectively. The difference in mean VAS score of both the groups at 1,2,4,8 and 10 hours was observed to be significant. However at rest of the time interval, the difference in mean VAS core of both the groups was statistically non-significant.

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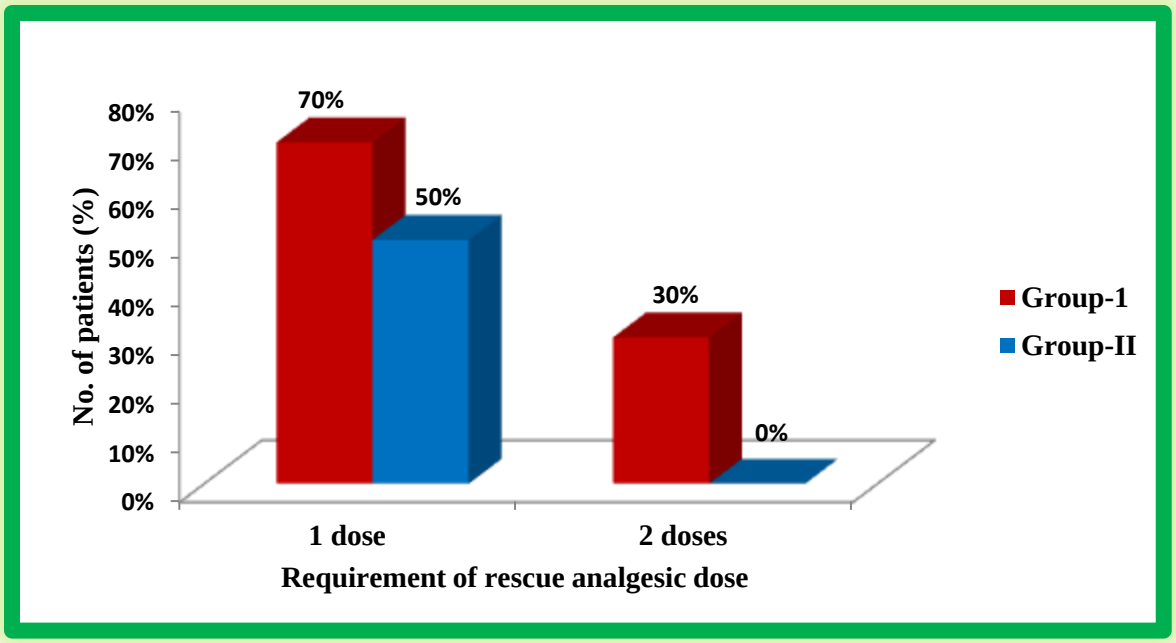

Figure 1- Comparision of requirement of number of rescue analgesic doses in 24hrs in both the study groups.

Table 3- Comparision of mean VAS score in both the study groups.

Time (hr)	VAS Score (Mean±SD)		p-value
	Group-I (n=50)	Group-II (n=50)	
1hr	1.36±0.75	1.06 ± 0.59	**0.028**
2hr	1.64±0.48	1.34 ± 0.52	**0.004**
4hr	1.76 ± 0.48	1.52 ± 0.50	**0.016**
6hr	2.32 ± 1.06	2.06 ± 0.24	0.093
8hr	2.80 ± 1.09	2.02 ± 0.32	**0.000**
10hr	3.16 ± 1.22	2.40 ± 0.86	**0.000**
12hr	2.10 ± 0.61	2.36 ± 1.16	0.163
14hr	2.14 ± 0.64	2.16 ± 1.25	0.919
16hr	1.60 ± 0.49	1.70 ± 0.95	0.512
24hr	1.38 ± 0.60	1.40 ± 1.11	0.911

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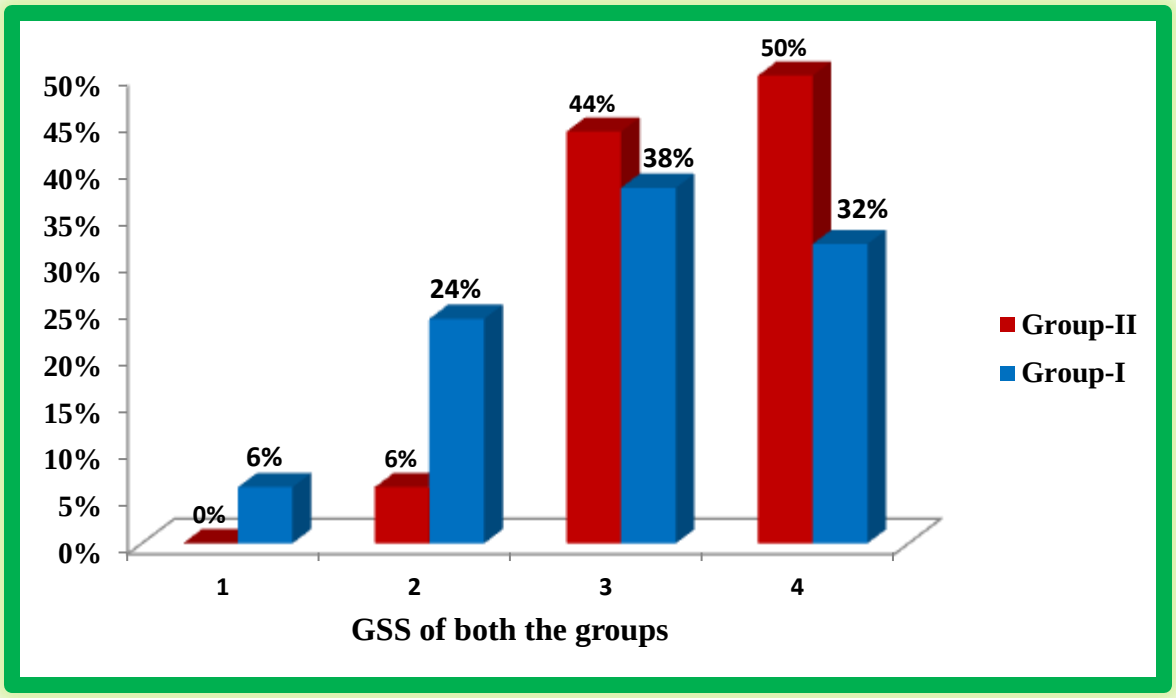

Figure 2- Comparision of the Global Satisfaction Score (GSS) in both the study groups.

Figure 2 depicts the patient's satisfaction with pain control by GSS. In our study, 25 (50%), 22 (44%), 3 (6%) & 0 (0%) patients from group-II showed GSS 4,3,2 & 1 consecutively and from group-I, 16 (32%),19 (38%),12 (24%) & 3 (6%) patients showed GSS 4,3,2,& 1 respectively. We observed significant association of type of post operative analgesia approach used in our study after LC with the patient's satisfaction with pain control.

Discussion-

This study was done on 100 gall bladder illness patients planned for LC at GMC, kathua, Jammu, J&K. Patients were assigned randomly to any of the two groups each having 50 patients. Both the groups were given roipivavcaine with dexamethasone but with different technique, group-I received US guided dual TAP block and group-II received "intraperitoneal instillation" and "periportal infiltration" of LA. The TAP block technique used in this research is a "US-guided 4-quadrant dual-block" defined by Chen et.al.[15]. Borglum et.al.[16] did it for the first time by using 4-point approach, and it named so by Niraj et.al.[17] The LA concentration used in this study was based on the previous study which proves it to be effective without increasing its concentration in plasma above safe limit. The mean age of our study subjects in both the groups

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was comparable and the difference in mean age was non-significant. This finding is similar to the outcome of study by Metwally et al.,[18] and Çevikkalp et al.,[19] Further our study was comprised of more males than females which is in contrast to study by Metwally et al.,[18] and Bhattarai et al.[20] The mean weight and height of subjects in present study in both groups was almost similar and the outcome is in accord with the study by Suseela, et al.[21] In current research, patient distribution among two groups according to ASA physical status is in contrast to previous studies as they were comprised of patients with ASA physical status I or II only.

LC is a minimally invasive method for gall bladder disease with pain as its significant issue mainly in initial few hours and in our study group-II reported lesser VAS score compared to group-I in initial 10hrs and was also significant except at 6hr. At rest of the time interval up to 24hr group-II reported non-significantly slightly higher VAS score than by group-I. This finding signifies that the group-II which received combined "intraperitoneal instillation and periportal infiltration" of LA experienced much lesser pain than the patients who received US guided dual TAP block. This outcome of our study is not in agreement with research by Eshak et al.[22] as they reported dual TAP block patients to experience lesser pain than their counter parts. The probable reason behind this disagreement could be the concentration of LA being used by them. Though noticeable individual inconsistency of pain is typical after LC[23] so the exact basis for this significant variability is not clear. A study by Maria Rita Di Pace et.al.[24] supported our findings since they found combined "intraperitoneal instillation and periportal infiltration" to be better approach than alone. Another study by Houben et.al.[25] also is in harmony with us as they observed that US-guided dual TAP block had no benefit over spinal anesthesia. Additionally in current study, GSS also indicated that group-II patients were more satisfied with pain control as maximum patients scored 4 and 3 with no patient having 1 score and in contrast, group-I had patients with score 1 as well. Further first request for rescue analgesia by group-II patients in our study was significantly late than group-I. The finding of our research which indicates combined "intraperitoneal instillation and periportal infiltration" to be better approach than US guided dual TAP block is that, in the first eight hours none of the patient from group-II demanded the rescue analgesia and at the 10hr only 20% patients required rescue analgesia. On the other hand in group-I, up to 10hr all the 50(100%) patients demanded rescue analgesia and the finding were significant. Additionally, none of the patients from group-II required 2nd dose of rescue analgesia besides this the 30% of group-I patients required 2nd dose and these findings were also

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significant. Studies have proved that effectively managing postoperative pain can reduce opioid exposure risk & significantly check the diversion of overload drug for abuse.[26] This could be the justification for our above findings. All the outcomes of our research signifies combined "intraperitoneal instillation and periportal infiltration" as the valuable and superior approach. The possible basis for our findings could be the technique used in our research. The pain related with LC has a visceral and somatic component and shoulder tip pain.[27] The study by Bisguard et.al.[28] and Ure et.al.[29] suggested parietal pain to be predominant on the other hand, many authors documented visceral pain as the main component[30,31] The US guided 4 quadrant TAP block used in this research provides more reliability in injecting LA in the correct plane reducing the chance of complications and gives analgesia to whole abdomen wall only i.e. parietal wall. However the intraperitoneal instillation in the combined "intraperitoneal instillation and periportal infiltration" used in our study blocked visceral & shoulder pain and the portside infiltration blocked parietal pain. So our research be in agreement with the previous studies[32] that the LC postoperative pain has a significant visceral component and this becomes the basis for the justification of our findings that combined "intraperitoneal instillation and periportal infiltration" is more effective and reduces considerable pain when compared to US guided dual TAP block as it blocks all the components of pain including the visceral component

Conclusion-

This research was performed to compare efficiency of "US guided dual TAP block" with intraperitoneal instillation and periportal infiltration technique. Our Study finds both the approaches to be comparable with intraperitoneal instillation and periportal infiltration technique to be more effective and better than the other approach. We suggests that, combined intraperitoneal instillation and periportal infiltration can be a promising approach of LA during LC as these patients experienced less pain, belatedly demanded first rescue analgesia, required less postoperative analgesia and showed more satisfaction with pain control than the patients who received US guided dual TAP block.

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Conflict of interest- None

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