

A Comparative Study between Plain Ropivacaine and Ropivacaine Plus Fentanyl in Laparoscopic Surgery Via Intraperitoneal Route

Chandni Soni*, Heena Chhanwal**, Nayna Solanki***, Jaimish Gajjar****

Abstract

Objective: To compare the analgesia, sedation and use of rescue analgesics after intraperitoneal instillation of 0.2% plain ropivacaine versus 0.2% ropivacaine plus fentanyl in laparoscopic surgeries. **Method:** A double blind prospective randomized study was carried out in 100 ASA grade 1 and grade 2 patients undergoing laparoscopic surgeries. They were divided into 2 equal groups. One group (Group A) received plain ropivacaine 0.2% 2mg/kg while other group (Group B) received ropivacaine 0.2% 2mg/kg plus fentanyl 2microgm/kg via intraperitoneal route before removal of trocar at the end of surgery. Visual analogue scale and Ramsay sedation score were used to assess postoperative pain and sedation at every 2 hour for first 12 hours, then 6 hourly till 24 hours and then 12 hourly for total of 48 h after surgery. The time of rescue analgesics was also compared between the two groups. **Result:** The demographic data was comparable between the two groups in terms of age, sex, weight and duration of surgery. The p value was significant between the two groups in terms of Visual analogue scale and Ramsay sedation score. Group B showed better postoperative pain relief and sedation as compared to group A. Also there was less need of rescue analgesia in group B in comparison to group A.

Conclusion: intraperitoneal ropivacaine plus fentanyl gives better postoperative pain relief, sedation and less use of other rescue analgesics compared to plain ropivacaine in laparoscopic surgeries.

Keywords: Ropivacaine; Fentanyl; Laparoscopic Surgery; Intraperitoneal Route

Introduction

Laparoscopic surgery, also called *minimally invasive surgery* (MIS), *band aid surgery*, or *keyhole surgery*, is a modern surgical technique in which operations are performed far from their location through small incisions (usually 0.5–1.5 cm) elsewhere in the body. Smaller incision reduces pain and shortens recovery time as well as results in less post-operative scarring. There are three components of pain after laparoscopic surgeries:

1. Visceral pain results from the stretching of intra-abdominal cavity and peritoneal inflammation.
2. Shoulder pain results from phrenic nerve irritation caused by residual carbon dioxide in the peritoneal cavity.
3. Parietal pain due to surgical incision which is much less in intensity by virtue of its small size [1].

Recently peripheral use of local anaesthetics for postoperative pain

relief has become a popular practice after laparoscopic surgery. Intraperitoneal instillation of local anesthetic has been most promising to minimize postoperative pain after laparoscopy surgery. Several reports are available on the efficacy of intraperitoneal administration of local anesthetic for analgesia after laparoscopic surgery. Combinations of intraperitoneal local anesthetic with many opioids have also been studied [1].

Ropivacaine is a long-acting amide local anaesthetic agent and first produced as a pure enantiomer. It is bound to plasma proteins to an extent of 94%, molecular weight: 274.4 g/mol with Pka-8.1 at 25 °c. It acts by causing reversible inhibition of sodium ion influx, and thereby blocking impulse conduction in nerve fibers [2]. This action is potentiated by dose-dependent inhibition of potassium channels [3]. Its safe dose is 2-3 mg/kg.

Fentanyl is a narcotic that has been successfully used as an adjuvant to local anesthetics,

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prolonging its action with better analgesia and anesthesia [4]. The use of different drugs as adjuvants to local anesthetics is widely practiced now-a-days aiming to prolong their duration of action. Fentanyl, a synthetic opioid which proved its efficacy when added to bupivacaine, was also shown to have a local anesthetic action [5, 6, 7]. The effect of fentanyl could be mediated through a direct action on the peripheral opioid receptors, in the primary afferent tissues (dorsal roots)[5], or through centrally mediated opioid receptor analgesia after being uptake into the systemic circulation[9]. The addition of opioids to local anesthetics showed a synergistic interaction in many previous studies [8, 9].

In this study we have compared the effect of intraperitoneal instillation of plain ropivacaine to that of ropivacaine plus fentanyl for post-operative pain relief in laparoscopic surgeries.

Aim of the Study

To compare intraperitoneal instillation of plain ropivacaine with ropivacaine and fentanyl in laparoscopic surgeries such as analgesia, sedation, use of rescue analgesia and post-operative complications.

Material and Method

A prospective randomized double blind controlled study was carried out in 100 patients posted for laparoscopic surgeries. Various laparoscopic surgeries were included in the study viz., laparoscopic cholecystectomy, laparoscopic appendectomy, laparoscopic hernioplasty, diagnostic hysterolaparoscopy and total laparoscopic hysterectomy. Only those surgeries were included in the study which was less than 180 minutes in duration. 100 patients were divided into 2 equal groups using a computer-generated table of random numbers:-

Group A: received plain ropivacaine 0.2% 2mg/kg via intraperitoneal route.

Group B: received ropivacaine 0.2% 2mg/kg plus fentanyl 2 micro/kg via intraperitoneal route.

Inclusion Criteria: Age group 20-50 year, weight 40-80 kg, ASA grade I and II, elective laparoscopic surgeries of maximum 180 minutes duration.

Exclusion Criteria: Systemic disease, Drug Allergy, Age <20 and >50, weight <40 and >80 kg, ASA III

and >III and laparoscopic surgeries >180 minutes duration.

Pre Anaesthetic examination

On the day before surgery, routine investigations viz., CBC, RBS, RFT, LFT, CHEST X RAY, ECG were carried out. An informed written consent was obtained from the patients. Patients were kept NBM- for 6 hours.

On the day of surgery: Patient were shifted to pre-anesthetic care unit, all monitors were applied viz SpO₂, ECG, NIBP. A wide bore I.V. cannula was taken and I.V. fluids were started. Patient were explained the visual analogue scale(VAS).

Patients were shifted to the operation theatre (OT) and premedicated with: Inj. Glycopyrrolate 0.004 mg/kg intravenous Inj. Ondansetron 0.1mg/Kg intravenous Inj. Ranitidine 1mg/kg intravenous Inj. Midazolam 0.05mg/Kg intravenous Inj. Fentanyl 2µg/kg i.v. Induction was done with Inj. Propofol 2mg/kg intravenous and muscle relaxant Inj. Succinylcholine 2mg/kg intravenous was given. Thereafter oral intubation was done with Portex cuffed ET Tube of appropriate size and patients were maintained with O₂ (50%) + N₂O (50%) + Isoflurane (1-1.5%) + Muscle relaxant, Inj. Vecuronium bromide 0.01mg/kg i.v. Ventilation was done with tidal volume 8-10ml/kg. Patients were given reverse trendelenburg position, CO₂ insufflation was done and intra-abdominal pressure was limited to 10-12 mm of Hg. The surgeon administered 2% injection lignocaine 2-3 ml at the trocar insertion site and skin infiltration was done at all the port sites before starting the surgery. During the operation non-invasive blood pressure (B.P.), heart rate (ECG), EtCO₂ and peripheral oxygen saturation (SpO₂) were monitored regularly. Patients were reversed with neostigmine 0.05 mg/kg + Inj. Glycopyrrolate 0.008 mg/kg intravenous and extubated after proper suctioning. Patients were shifted to the post-anaesthesia-care unit (PACU) after they regained full consciousness and obeyed all verbal commands.

Patients were randomized into two groups, group A and group B as described above. The surgeon and the anaesthetist in the PACU were unaware of the groups to which each patient was randomized. The drug was injected intraperitoneally before the removal of trocar at the end of the surgery.

Before induction of anesthesia, patients were instructed on how to use *Visual analogue scale (VAS)*, A 100 mm scale with anchors ranging from 'no pain' to 'worst possible pain', 0- no pain and 100- worst

possible pain. Ramsay sedation scale (RSS) for sedation was used with the following scores:

1. Patient is anxious and agitated or restless, or both.
2. Patient is co-operative, oriented, and calm.
3. Patient responds to commands only.
4. Patient responds to light glabellar tap or loud auditory stimulus.
5. Patient exhibits a sluggish response to light glabellar tap or loud auditory stimulus.
6. Patient exhibits no response.

Those patients with VAS scores > 40 after surgery were administered a bolus of diclofenac aqueous 75 mg IV as rescue analgesia. Rescue analgesic agents are medications prescribed in addition to regularly scheduled analgesic medications, which are intended to be taken during episodes of pain not controlled by a patient's scheduled analgesic regimen[10].

Postoperatively following parameters were recorded at every 2 hours for first 6 hours then 6 hourly up to 24 hours and then 12 hourly for total 48 hours after surgery: Pulse, Mean Arterial B.P (MAP), Visual Analogue Scale Score(VAS), Ramsay Sedation Score(RSS), Time of rescue analgesia and Postoperative complications like Nausea, Pruritis, Hypotension, Bradycardia, Shoulder Pain and others.

Statistical Data: For statistical analysis, SPSS version 12.0 was used. Data was presented as Mean \pm SD or proportion (%). Unpaired t test was used to get the results and $p < 0.05$ was considered significant.

Discussion

Laparoscopic surgeries due to its various advantages are now the preferred surgical technique over open surgeries. Numerous advantages have been reported when comparing open versus minimally invasive abdominal surgical procedures (laparoscopy), including earlier return of bowel function, decreased postoperative pain, quicker recovery, and earlier hospital discharge [11]. The occurrence of post-operative pain, although less severe than in open surgery, may affect length of hospital stay and early return to normal activity in some patients operated on with laparoscopic surgery[12] and thereby increase the cost of such care. In addition to pain at the incisional and trocar insertion sites, there may also be shoulder and

diffuse abdominal pain [14]. Ropivacaine alone or combined with fentanyl provides great pain relief when instilled intraperitoneally. Dinesh Singh et al concluded that intraperitoneal instillation of ropivacaine is an easy, cheap and non-invasive method which provides good analgesia in the immediate postoperative period after laparoscopic surgeries [13]. Kahokehr et al in his study investigated the effects of intraoperative instillation and postoperative infusion of IPLA ropivacaine after colectomy and concluded that not only there is an overall reduction of pain, opioid analgesia use, need for rescue analgesia, postoperative cortisol, and glucose response.[14] but also it improves early surgical recovery[15].

Bina P. Butala et al concluded that intraperitoneal instillation of local anesthetic and opioid is an easy, cheap, and non-invasive method which provides good analgesia in the immediate postoperative period after laparoscopic surgery. The combination of intraperitoneal bupivacaine with morphine is superior to the plain bupivacaine for the relief of postoperative pain in patients undergoing laparoscopic gynecological surgery without any significant increase in adverse events. This peripheral action of opioid particularly in inflamed tissue provides support for the existence of peripheral opioid receptors and gives a new approach to pain management which may have great clinical benefits [1]. Various concentration and volume of ropivacaine have been used for intraperitoneal instillation. In this study we have used 0.2 % ropivacaine with a dose of 2 mg/kg and fentanyl as an adjuvant in dose of 2 microgram/kg. Tae Han Kim et al used ropivacaine 2mg/kg diluted in 100ml of normal saline [16].

In the present study both the groups were demographically comparable in terms of age, sex, weight and duration of surgery. As shown in table 1 there was no significant difference between group A and group B.

As shown in fig. 1 and 2 , postoperative pulse showed significant difference till 18 hours while mean arterial B.P. (MAP) did not show any significant difference after 2 hours of surgery. Pulse rate was lower in group B compared to group A due to more dense and prolonged analgesia systemic absorption of fentanyl from peritoneal cavity. Also incidence of bradycardia was more in group B than in group A. MAP did not show significant difference due to early use of rescue analgesia. Our results are similar to those found by Singh A et al, Gupta et al, Taehankim et al and Goldstein et al [16, 17, 18, 19].

As shown in table 2, VAS score was highly significant up to 6 hours postoperatively ($p < 0.001$)

and did not show any significant difference after 18 hours of laparoscopic surgery. Singh A et al and Bina P. Butala et al also found significant difference in VAS scores between the opioid plus local anesthetic and plain anesthetic group [1, 19].

As shown in table 3, RSS also showed significant difference up to 6 hours of surgery ($p < 0.05$), thereafter there was no significant difference. Group B patients compared to group A were more cooperative, oriented and calm compared to group A. The reason for this might be due to systemic absorption of fentanyl after intraperitoneal instillation. Agitation of the patient was mostly due to the pain and it was seen in more number of patients and earlier in Group A compared to Group B.

At postoperative 6th hour VAS scores of group B and group A was 5.600 ± 1.218 and 37.60 ± 2.689 respectively while RSS scores of group B and group A were 2.000 ± 0.0 and 1.680 ± 0.06664 respectively (table 2 and 3); implying ropivacaine plus fentanyl group is better in terms of sedation and analgesia than plain ropivacaine group. The VAS score is not significant after 18 hours ($p > 0.05$) but the analgesia provided by ropivacaine plus fentanyl group is much longer compared to plain ropivacaine group.

Also the rescue analgesia time was highly significant between both the groups. Time of rescue

analgesia in plain ropivacaine group was 9.440 ± 0.7857 while that in ropivacaine plus fentanyl group is 39.60 ± 1.571 . Number of patients receiving rescue analgesia was more in group A than in group B. Also the duration of rescue analgesia after surgery was earlier in group A than in group B. Similar results were found by Singh A et al and Bina P. Butala et al [1, 19].

A Singh et al in his study concluded that intraperitoneal instillation of ropivacaine with fentanyl reduces not only the intensity of visceral, parietal and shoulder pain but also the total rescue analgesic dose consumption [19]. Bina P. Butala also concluded that combination of intraperitoneal opioid plus local anesthetic is superior to plain local anesthetic [1].

As shown in table 4, the postoperative complications in Group B were slightly more than that in Group A but were not significant. Bradycardia and hypotension was seen more in group B than in group A. Results of Singh A. et al were correlated well with our study in terms of bradycardia and hypotension [19].

Group A though has less complications yet needs early rescue analgesia compared to group B while the sedation and analgesia duration is longer in group B than in ropivacaine group A.

Observation and Results

Table 1: The demographic data of both groups were comparable and showed no significant difference

Demographic characteristics of study population (Mean±SD)			
VARIABLES	ROPIVACAINE PLAIN(n=50)	ROPIVACAINE PLUS FENTANYL(n=50)	p value
Age (years)	36.00 ± 1.673	35.16 ± 1.497	0.7091
Weight (kg)	54.68 ± 1.113	58.34 ± 1.192	0.6299
Duration(minutes)	89.60 ± 5.247	90.80 ± 4.317	0.8602
Sex (M:F)	1M:5.2F	1M:4F	

Fig 1: Postoperative pulse showed significant difference till 18 hours thereafter, the difference was insignificant

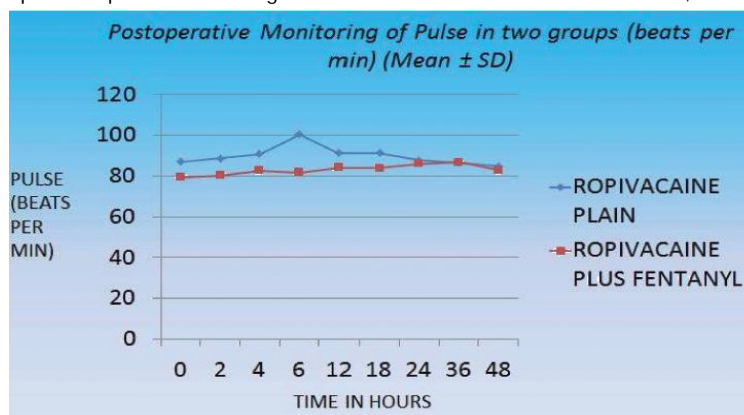


Fig 2: Mean arterial B.P. (MAP) didn't show any significant difference after 2 hours of surgery between the two groups

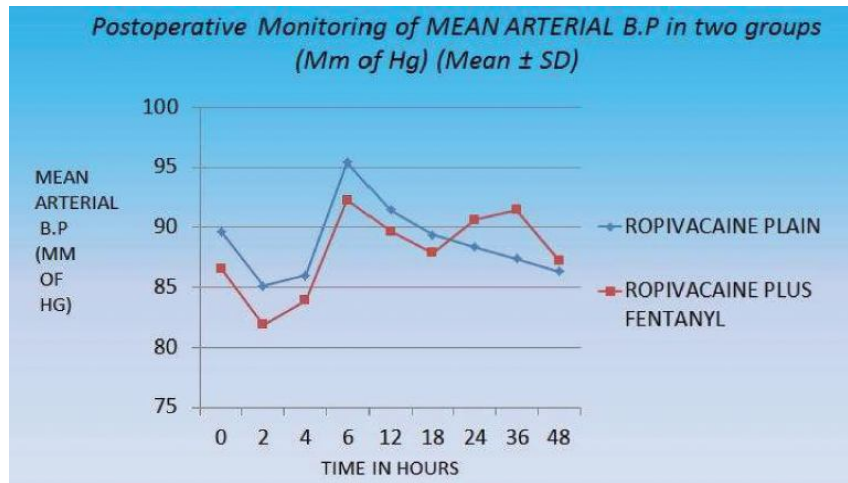


Table 2: VAS score was highly significant up to 6 hours postoperatively ($p < 0.001$) and did not show any significant difference after 18 hours of laparoscopic surgery

VAS SCORE (Mean ± SD)			
Time (HOURS)	ROPIVACAINE PLAIN(n=50)	ROPIVACAINE PLUS FENTANYL(n=50)	p-value
0	7.200 ± 1.247	0.0 ± 0.0	< 0.0001
2	14.40 ± 1.620	2.000 ± 0.5714	< 0.0001
4	22.40 ± 2.223	2.800 ± 0.6414	< 0.0001
6	37.60 ± 2.689	5.600 ± 1.218	< 0.0001
12	19.20 ± 2.283	11.60 ± 1.793	0.0102
18	21.60 ± 2.513	12.80 ± 1.830	0.0056
24	20.20 ± 1.443	18.00 ± 2.556	0.4552
36	15.80 ± 1.644	20.80 ± 2.678	0.1147
48	10.00 ± 1.895	14.00 ± 1.616	0.1115

Table 3: RSS also showed significant difference up to 6 hours of surgery ($p < 0.05$), thereafter there was no significant difference

RSS SCORE (Mean ± SD)			
Time (HOURS)	ROPIVACAINE PLAIN(n=50)	ROPIVACAINE PLUS FENTANYL(n=50)	p-value
0	1.960 ± 0.02799	2.000 ± 0.0	0.1562
2	1.920 ± 0.03876	2.000 ± 0.0	0.0416
4	1.680 ± 0.06664	2.000 ± 0.0	< 0.0001
6	1.680 ± 0.06664	2.000 ± 0.0	< 0.0001
12	1.920 ± 0.03876	1.960 ± 0.02799	0.4048
18	1.860 ± 0.04957	1.960 ± 0.02799	0.0821
24	1.980 ± 0.0200	1.880 ± 0.04642	0.0507
36	1.840 ± 0.05237	1.760 ± 0.06101	0.3222
48	1.960 ± 0.02799	2.000 ± 0.0	0.1562

Table 4: The post operative complications were very few in both groups but were more in the ropivacaine plus fentanyl group than in plain ropivacaine group

Post Operative Complications(%)		
	ROPIVACAINE PLAIN	ROPIVACAINE PLUS FENTANYL
Nausea	0	0
hypotension	0	4%
shoulder pain	0	0
Bradycardia	4%	12%
pruritis	0	0
others	0	0

Conclusion

Ropivacaine alone and Ropivacaine plus Fentanyl both provide good analgesia postoperatively when given intraperitoneally in laparoscopic surgeries. But comparatively Ropivacaine plus Fentanyl, provides better analgesia, sedation and less need of rescue analgesia compared to plain Ropivacaine group.

Future of the study

As we continue to strive to improve the analgesia and facilitate the postoperative outcome following laparoscopic procedures, future studies are needed to address the optimal combination of medications to provide postoperative analgesia, as well as the potential role for other anesthetic techniques. With the current trend in the cost development, Ropivacaine will most likely be used increasingly in the future.

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