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Original Article

A Comparative Study between the Efficacy of Pre-incisional and Post-incisional Wound Infiltration of Bupivacaine for the Relief of Post-operative Pain

Shamala Dinkar Yashod[1], Vaijayanti Nitin Gadre[2]

[1]Assistant Professor, Department of Anesthesia, Seth Gordhandas Sunderdas Medical College and King Edward Memorial Hospital, Mumbai, Maharashtra, India, [2]Professor, Department of Anesthesia, Grant Government Medical College, Mumbai, Maharashtra, India

Abstract

Introduction: Pain, the "fifth vital sign" is an unpleasant sensation localized to a part of the body. Post-operative pain has been widely studied, as it causes adverse psychological and physiological effects. Many anesthetic agents and techniques have been developed to minimize the post-operative pain. This study compares the effectiveness of two such techniques: Pre-incisional and post-incisional infiltration using bupivacaine as the anesthetic agent.

Materials and Methods: This prospective, randomized, non-crossover type, double-blind interventional study was conducted on 60 patients of either gender, aged 15–50 years, belonging to the American Society of Anesthesiologists Grades I and II undergoing lower abdominal surgeries. They were randomly divided into two groups: Pre-incisional and post-incisional infiltration groups and were monitored for up to 24 h postoperatively for the duration of analgesia and intensity of pain.

Results: The duration of post-operative analgesia was better in the pre-incisional infiltration group (540 min) compared to the post-incisional infiltration group (360 min). Similarly, the overall mean pulse rate, mean systolic blood pressure (SBP), and mean respiratory rate were lower in the pre-incisional infiltration group, indicating better post-operative pain relief.

Conclusion: Although both pre-incisional and post-incisional infiltration of bupivacaine are safe, pre-incisional infiltration provides better relief of post-operative pain.

Key words: Bupivacaine, Post-incisional, Post-operative pain, Pre-incisional, Visual analog scale

INTRODUCTION

Pain, the "fifth vital sign"[1] is an unpleasant sensation localized to a part of the body. The word pain which causes majority of us shudder with fear is derived from the Greek word "poine" which means penalty or punishment.

In 1979, the International Association for the Study of Pain defined that pain is "An unpleasant sensory and emotional experience associated with actual or potential damage, or described in terms of such damages."[2] Post-operative pain is associated with adverse psychological and physiological effect. The adverse physiologic effect of post-operative pain includes respiratory compromise from reflex splinting of respiratory and abdominal muscles, increased myocardial work and oxygen consumption, peripheral vasoconstriction, gastrointestinal and urinary dysfunction, impairment of muscle metabolism, and decreased physical activity.

Post-operative pain is maximum in the first 48 h. Various methods such as systemic narcotics, nonsteroidal anti-inflammatory drugs, neuraxial anesthetics techniques and nerve blocks, local anesthetic infiltration, epidural narcotics, and psychological methods which are employed to relieve pain during this period.

Topical infiltration of local anesthetics at the surgical site is a simple, easy, and attractive technique recommended for providing a longer post-operative pain-free period and decreased analgesic requirements.

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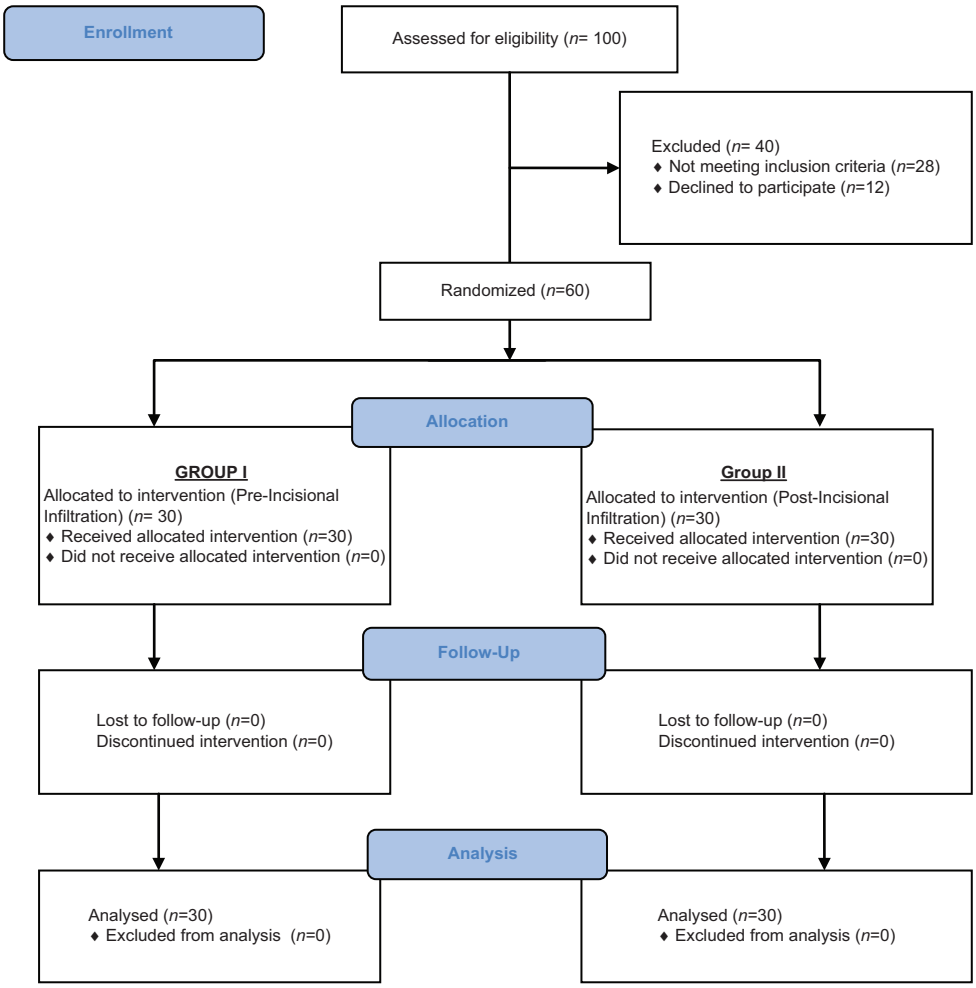
Corresponding Author: Dr. Vaijayanti Nitin Gadre, C/o Shri Nitin R. Gadre, Flat 11, Suniti Building, Opposite Mantralaya, General Jagannath Bhosale Marg, Near Sachivalaya Gymkhana, Mumbai - 400 021, Maharashtra, India



Surgical incision provokes two kinds of modifications in the responsiveness of the nervous system: Peripheral sensitization and central sensitization. Peripheral sensitization is a reduction in the threshold of nociceptor afferent peripheral terminals. Central sensitization is an N-methyl-D-aspartate (NMDA) receptor-mediated activity-dependent increase in the excitability of dorsal horn neurons.[3] This causes post-operative pain hypersensitivity state which manifests as an increase in the response to noxious stimuli and a decrease in the pain threshold. This leads to amplification and prolongation of post-operative pain. Infiltration of local anesthetics in the area of the skin before surgical incision pre-empts post-operative pain by preventing the establishment of peripheral and central sensitization

Therefore, this study was undertaken to compare the efficacy of pre-incisional and post-incisional wound infiltration of bupivacaine for post-operative pain relief in lower abdominal surgeries. The study compares the duration of analgesia, severity of pain, and demand for additional analgesics required for the first 24 h after the surgery in the above groups.

MATERIALS AND METHODS

This is a prospective, randomized, non-crossover type, double-blind interventional study, conducted in B. J. Medical College and Sassoon General Hospital, after obtaining permission from the Institutional Ethics Committee. This study was carried out on 60 patients belonging to either sex and ranging from 15 to 50 years of age, belonging to the American Society of Anesthesiologists Grades I and II, undergoing lower abdominal surgeries lasting for not more than 2 h under general anesthesia. A written informed consent was taken from all the patients.

Patients not providing consent, having a history of addiction, pre-medication with analgesic drugs, and psychiatric illness were excluded from the study. Routine investigations such as hemogram, urine for sugar and albumin, bleeding time, clotting time, blood sugar level, blood urea level, and serum electrolytes were done. Other investigations were carried out wherever necessary.

Patients were randomly divided into two groups of 30 patients each:

- Group I: Pre-incisional infiltration group
- Group II: Post-incisional infiltration group

20 ml of 0.25% bupivacaine was infiltrated 5 min before incision in Group I and after induction in Group II. The time of skin incision was taken as "zero" in both the groups.

The following parameters were monitored:

1. Time of infiltration
2. Time of incision
3. Vitals were monitored intraoperatively and up to 24 h postoperatively
4. Severity of pain: It was measured by visual analog scale (VAS) with 1 indicating "No Pain" and 10 indicating "maximum imaginable pain." The scores were graded as
   - Mild: 1–3
   - Moderate: 4–6
   - Severe: 7–10
5. Requirement of analgesic (Inj. diclofenac sodium).

Statistical Analysis

The data were analyzed using SPSS software. The quantitative data were analyzed using "*t*-test" and the qualitative data were analyzed by Chi-square test. $P < 0.05$ was considered to be statistically significant.

RESULTS

Both the groups were comparable in terms of demographic variables and physical attributes. The mean duration of surgeries was 108.67 ± 5.49 min in Group I and 106.67 ± 3.30 min in Group II. However, the difference was statistically not significant ($P = 0.09$).

The mean duration of analgesia (time for the requirement of the first dose of analgesic) was 9.1 ± 0.9 h in Group I and 5.7 ± 0.8 h in Group II, and this was statistically significant ($P < 0.0001$).

The mean analgesic requirement, in terms of injections of diclofenac sodium, in the post-operative period was 1.4 ± 0.5 in Group I and 2.0 ± 0.7 in Group II. However, the difference was statistically not significant ($P = 1$).

The mean pulse rate [Table 1], mean SBP [Table 2], and mean respiratory rate [Table 3] were overall significantly less in Group I as compared to Group II, from 8 h onward. The severity of pain, as measured by the VAS, was significantly less than Group I than in Group II [Table 4].

No incidence of adverse effects was noted in any group.

DISCUSSION

Physiologic studies have confirmed that a painful stimulus does not merely transmit a nociceptive signal to the central nervous system. It may trigger a complex cascade of physiological alterations in the somatosensory system, which lowers the dorsal horn neuron thresholds, sensitizing the peripheral and central pain pathways.[4-6] The response

Table 1: Comparison of mean pulse rate in Groups I and II

Parameter	Group I (Mean±SD)	Group II (Mean±SD)	*P*-value	Statistical significance
Pre-operative	82.60±7.87	80.73±10.04	0.43	Not significant
2 h post-operative	78.27±3.43	78.70±4.37	0.67	Not significant
4 h post-operative	79.93±2.00	78.80±5.12	0.26	Not significant
6 h post-operative	76.70±3.61	77.87±4.42	0.27	Not significant
8 h post-operative	78.80±5.12	88.97±3.18	<0.0001	Significant
10 h post-operative	91.60±3.14	82.83±4.50	<0.0001	Significant
16 h post-operative	82.83±4.50	91.13±4.44	<0.0001	Significant
20 h post-operative	89.13±2.85	89.13±2.85	1.00	Not significant
24 h post-operative	91.13±4.44	100.43±5.97	<0.0001	Significant

SD: Standard deviation

Table 2: Comparison of mean systolic blood pressure in Groups I and II

Parameter	Group I (Mean±SD)	Group II (Mean±SD)	*P*-value	Statistical significance
Pre-operative	124.27±8.51	120.00±8.30	0.054	Not significant
2 h post-operative	115.27±6.23	113.87±7.31	0.43	Not significant
4 h post-operative	116.53±6.28	115.87±6.77	0.69	Not significant
6 h post-operative	120.13±5.48	117.93±5.55	0.13	Not significant
8 h post-operative	120.20±5.07	127.20±4.86	<0.0001	Significant
10 h post-operative	123.07±4.13	121.93±2.99	0.23	Not significant
16 h post-operative	115.87±6.77	123.07±4.13	<0.0001	Significant
20 h post-operative	125.27±2.90	125.27±2.90	1.00	Not significant
24 h post-operative	123.07±4.13	138.93±3.92	<0.0001	Significant

SD: Standard deviation

Table 3: Comparison of mean respiratory rate in Groups I and II

Parameter	Group I (Mean±SD)	Group II (Mean±SD)	*P*-value	Statistical significance
Pre-operative	15.87±1.38	14.87±1.59	0.01	Significant
2 h post-operative	13.33±0.61	13.13±1.01	0.36	Not significant
4 h post-operative	13.83±0.65	13.47±0.90	0.08	Not significant
6 h post-operative	13.33±0.61	13.67±0.84	0.08	Not significant
8 h post-operative	13.83±0.65	15.63±1.38	<0.0001	Significant
10 h post-operative	15.57±1.17	14.00±0.79	<0.0001	Significant
16 h post-operative	13.67±0.84	15.57±1.17	<0.0001	Significant
20 h post-operative	13.80±0.81	13.80±0.81	1.00	Not significant
24 h post-operative	15.57±1.17	16.90±1.06	<0.0001	Significant

SD: Standard deviation

Table 4: Comparison of mean visual analog scale scores in Groups I and II

Parameter	Mild (1–3)		Moderate (4–6)		Severe (7–10)		*P* value	Statistical significance
	Group I	Group II	Group I	Group II	Group I	Group II		
2 h post-operative	30 (100%)	30 (100%)	0	0	0	0	--	--
4 h post-operative	30 (100%)	30 (100%)	0	0	0	0	--	--
6 h post-operative	30 (100%)	30 (100%)	0	0	0	0	--	--
8 h post-operative	30 (100%)	5 (16.7%)	0	24 (80%)	0	1 (3.3%)	<0.0001	Significant
10 h post-operative	18 (60%)	5 (16.7%)	12 (40%)	23 (76.7%)	0	2 (6.7%)	<0.0001	Significant
16 h post-operative	10 (33.3%)	0	20 (66.6%)	27 (90%)	0	3 (10%)	<0.0001	Significant
20 h post-operative	5 (16.7%)	0	25 (83.3%)	25 (83.3%)	0	5 (16.7%)	<0.0001	Significant
24 h post-operative	0	0	30 (100%)	12 (40%)	0	18 (60%)	--	--

to subsequent or persisting painful stimuli may thereby be amplified, resulting in hyperalgesia, spontaneous pain, and allodynia. Pre-emptive analgesia intervention given before surgery may, therefore, prevent this sensitizing cascade, reducing the development and severity of post-operative pain.

The idea of pain was first introduced into clinical practice by Crile, in 1913,[7] and further developed by Wall[8] and Woolf[9] Pre-emptive analgesia embodies the idea that the pain perceived after a tissue injury may be modified by an analgesic administered before the precipitating noxious stimuli. It further envisages the idea that the timing of the analgesic is critical in its efficacy (e.g., that a given dose administered preceding the stimulus is more effective than the same dose given afterward).

Post-operative pain can be eliminated or reduced by various analgesic drugs and techniques. Narcotics form the mainstay of analgesics for acute control of moderate-to-severe pain. They produce excellent analgesia but require extensive patient monitoring. In the post-operative period, when the patients are experiencing pain and are drowsy, narcotic administration possesses a potential risk of respiratory depression. This has led to research for analgesics that are devoid of opioid side effects with effective potency.

In this study, bupivacaine was used as an analgesic to compare the efficacy of pre-incisional infiltration with post-incisional infiltration to relieve post-operative pain.

The study groups were similar in terms of demographic variables and physical attributes.

Duration of Analgesia

In this study, the duration of analgesia (as determined by the requirement of rescue analgesia postoperatively) was 9.1 ± 0.9 h (540 min) in the pre-incisional infiltration group and 5.7 ± 0.8 h (360 min) in the post-incisional infiltration group.

This was similar to the study by Alsaif *et al*.,[10] where the first analgesic request was made after 314.6 ± 76.7 min in the pre-incisional group and 2017.0 ± 8.36 min in the post-incisional infiltration group. Thus, the duration of analgesia was more in the pre-incisional infiltration group than the post-incisional infiltration group.

Similarly, in the study by Divecha *et al*.,[11] it was found that the duration of analgesia was longer in the pre-incisional infiltration group (7.5 ± 1.5 h) than in the post-incisional infiltration group (4.3 ± 1.7 h).

Total Analgesic Requirement

This refers to the total number of doses of injection of diclofenac sodium requirement in the first 24 h.

In this study, the mean requirement was lower in the pre-incisional infiltration group than in the post-incisional infiltration group. However, it was not statistically significant.

This was similar to the study by Olanipekun *et al.*,[12] which found no significant difference in the mean analgesic (paracetamol) requirement in both the groups.

This was similar to the study by Alsaif *et al.*[10] (pethidine) and Kato *et al.*[13] (diclofenac sodium). Furthermore, in the study by Lohsiriwat *et al.*,[14] it was found that both the total number of morphine injections and the amount of morphine used postoperatively in the pre-emptive group were less compared to the control group.

Pain Intensity

It was observed that the intensity of pain, as measured by the VAS score, was lesser in the pre-incisional infiltration group than in the post-incisional infiltration group. Mild (1–3) pain was seen 2 h postoperatively onward while moderate (4–6) and severe pain (7–10) were recorded 8 h postoperatively onward. There were no cases of severe pain in the pre-incisional infiltration group.

All the patients of the post-incisional infiltration group started experiencing moderate-to-severe pain from 16 h postoperatively onward. However, the same in the pre-incisional infiltration group started 24 h postoperatively onward.

Thus, overall control of pain was better in the pre-incisional infiltration group than in the post-incisional infiltration group, indicating better analgesia, up to 24 h postoperatively.

This was similar to the study by Alsaif *et al.*,[10] where lower pain scores were observed in the pre-incisional group than in the post-incisional group, at the end of 30 min, 2 h, 4 h, and 24 h.

Similarly, the studies by Olanipekun *et al.*,[12] Kato *et al.*,[13] and Lohsiriwat *et al.*[14] and found better analgesia in the pre-incisional infiltration group than in the post-incisional infiltration group.

Vital Parameters

The mean pulse rate was less in the pre-incisional infiltration group than in the post-incisional infiltration group, except at 4, 10, and 20 h postoperatively. This difference was clinically insignificant, but statistically significant from 8 h postoperatively onward (except at 20 h).

The mean SBP was more in the pre-incisional infiltration group than the post-incisional infiltration group up to 6 h postoperatively. However, the difference was clinically and statistically insignificant.

At 8 h, 16 h, and 24 h postoperatively, the mean SBP in the pre-incisional infiltration group was significantly lower than the post-incisional infiltration group. At 24 h postoperatively, a sharp rise was observed in the mean SBP, which was both clinically and statistically significant.

The mean respiratory rate was less in the pre-incisional infiltration group than in the post-incisional infiltration group 6 h postoperatively onward, except at 10 and 20 h postoperatively. This difference was clinically insignificant, but statistically significant from 8 h postoperatively onward (except at 20 h).

All these parameters indicate better post-operative pain relief in the pre-incisional infiltration group than in the post-incisional infiltration group, which correlates with the interpretation of the VAS score.

Though existing studies did not measure the post-operative pain through the vital parameters, however, these results can be compared with the studies that measured the intensity of post-operative pain through VAS scores. Thus, the findings are in accordance with the studies by Alsaif *et al.*,[10] Olanipekun *et al.*,[12] Kato *et al.*,[13] and Lohsiriwat *et al.*[14] and where pre-incisional infiltration was found to provide better post-operative pain relief than post-incisional infiltration.

Adverse Effects

No adverse events of any kind were noted in the study, indicating that bupivacaine is safe as pre-incisional and post-incisional infiltration.

Most of the studies did not include any adverse effect profile.

In the study by Divecha *et al.*,[11] where incidences of wound infection and hematoma were observed with ropivacaine. However, it was concluded that their sample size was inadequate to comment on the complication rates of wound infiltration.

Limitations

The study was limited by the outpatient department attendance of the patients requiring lower abdominal surgeries. Therefore, the results may not be generalized.

CONCLUSION

It can be effectively concluded from the study that though both pre-incisional and post-incisional infiltration of bupivacaine are safe (as evidenced by the lack of adverse effects), pre-incisional infiltration provides better analgesia and post-operative pain relief than the post-incisional infiltration, in terms of duration of analgesia, intensity of pain, and post-operative requirement of analgesic.

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