

Effect of preoperative application of buprenorphine transdermal patch on analgesic requirement in postoperative period in hip and knee replacement surgeries

Monu Yadav, C. Lalit Mohan¹, I. Srikanth, E. Roop Raj², R. Gopinath, P. Chandrasekhar¹

Departments of Anaesthesiology and Critical Care and ¹Orthopedics, Nizam's Institute of Medical Sciences, ²Department of Anaesthesiology and Critical Care, ESI Hospital, Nacharam, Hyderabad, Telangana, India

Abstract

Background and Aims: Although no pain control following hip and knee replacement surgeries has attained gold standard, it is clear that patients should have optimum pain control after total knee arthroplasty and total hip arthroplasty for enhanced satisfaction and function. We conducted this study to evaluate the effect of preoperative application of buprenorphine transdermal patch on analgesic requirement in perioperative period after knee and hip replacement surgeries

Material and Methods: Following institutional ethical committee approval and written informed consent, a prospective study was conducted in 50 patients of either gender belonging to ASA1 or ASA2 status, requiring either knee or hip replacement. The patients were assessed in preoperative period, and buprenorphine patch of 10 mg (sustained release of 10 µg/h) was applied either on the chest or on outer side of the arm 12 h before surgery. Total knee arthroplasty/total hip arthroplasty was done under combined spinal epidural blockade. Epidural infusion with 0.125% bupivacaine at a rate of 4–5 mL/h was continued in postoperative period. Intravenous opioid analgesics were avoided in postoperative period, and whenever required only iv paracetamol 1g was given. Outcome in terms of requirement of iv analgesic, visual analog pain score, any associated nausea vomiting, itching, and level of somnolence was noted in postoperative period at 1,2,3,4,8,12,16,20,24,48, and 72 h, respectively.

Results: None of the patient required rescue analgesia in the first 2 h. During 72 h postoperative period of observation 32% of patients demanded rescue analgesics at 8th hour, followed by 20% at 4th hour and 16% at 12th hour.

Conclusion: Preoperative application of transdermal patch significantly reduces the requirement of postoperative intravenous opioid and nonopioid analgesic drugs.

Keywords: Buprenorphine, hip replacement, knee replacement, transdermal patch

Introduction

Buprenorphine is a highly lipophilic, semi-synthetic derivative of thebaine, a morphine alkaloid.^[1] The molecular structure of buprenorphine confers suitability for use in a variety of preparations, including the transdermal route. Transdermal

drug delivery systems (TDDSs) are non-invasive, simple, compliant, and sustained methods of delivery. For usage as transdermal patch, buprenorphine is incorporated into an adhesive polymer matrix (acrylate vinyl acetate), from which it is continuously released into the systemic circulation over a period of 7 days.^[2] Buprenorphine transdermal patches are available in three strengths 5, 10, and 20 mg with rate of drug release of 5, 10, and 20 µg/h, respectively.

Address for correspondence: Dr. Monu Yadav,
Department of Anaesthesiology and Critical Care, Nizam's
Institute of Medical Sciences, Hyderabad, Telangana, India.
E-mail: monubalbir@yahoo.co.in

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: reprints@medknow.com

How to cite this article: Yadav M, Mohan CL, Srikanth I, Raj ER, Gopinath R, Chandrasekhar P. Effect of preoperative application of buprenorphine transdermal patch on analgesic requirement in postoperative period in hip and knee replacement surgeries. *J Anaesthesiol Clin Pharmacol* 2019;35:124-8.

Access this article online

Quick Response Code:



Website:
www.joacp.org

DOI:
10.4103/joacp.JOACP_13_17

No literature is available about the use of transdermal buprenorphine patch for postoperative analgesia after total knee arthroplasty and total hip arthroplasty. But literature supports use of transdermal buprenorphine patch for postoperative analgesia after abdominal surgical procedure.^[3] We conducted this study to evaluate the effect of preoperative application of buprenorphine transdermal patch on analgesic requirement in perioperative period after knee and hip replacement surgeries.

Material and Methods

Following institutional ethical committee approval and written informed consent, a prospective study was conducted in 50 patients of either gender belonging to ASA1 or ASA2 status, requiring either knee or hip replacement. Out of total 50 patients, 26 underwent total knee replacement (TKR) for primary osteoarthritis knee and 24 underwent total hip replacement (THR) for secondary osteoarthritis hip. Patients with skin allergies, refusal to consent, and severe hepatic dysfunction were excluded from the study. The patients included in study were assessed in preoperative period, and buprenorphine patch of 10 mg (sustained release of 10 µg/h) was applied either on chest or on outer side of arm 12 h before surgery. The transdermal buprenorphine patch should be applied to intact skin on the flat surfaces of the upper outer arm, upper chest, upper back, or the side of the chest. The skin should be dry, clean, non-irritated, non-hairy (hair should be trimmed with scissors, not shaved), and without large scars. The transdermal patch was applied 12 h preoperatively, as plasma concentration of buprenorphine increases only slowly within 12–24 h, to reach the analgesic threshold level (100 pg/mL). Total knee arthroplasty/total hip arthroplasty was performed under combined spinal epidural blockade. Epidural infusion with 0.125% bupivacaine at the rate of 4–5 mL/h with elastometric infusion pump was continued

in postoperative period. Intravenous opioid analgesics and opioid even as additive to epidural infusion were avoided in postoperative period. Rescue analgesia was given with only iv paracetamol 1g whenever required according to patient's request irrespective of the Visual Analog Scale (VAS) score [Figure 1]. Outcome in terms of requirement of iv analgesic, visual analog pain score, any associated nausea vomiting, itching, and level of somnolence was noted in postoperative period at 1,2,3,4,8,12,16,20,24,48, and 72 h, respectively. Nausea vomiting and pruritis were noted in terms of yes or no. Postoperative pain was noted as per the visual analog score.

Somnolence was categorized as follows:

1. Fully awake
2. Somnolent and responds to call
3. Somnolent and no response to verbal stimulation
4. Asleep and responds to only painful stimulation.^[4]

Statistical analysis

Data collected were subjected to statistical analysis. Data analysis was carried out using IBM SPSS ver. 21 (International business machines corporation, IBM India Private Limited, Bangalore, Karnataka, India) installed on Windows 7 operating system. MSExcel 2007 and MSWord 2007 software were also used in this study. We used Chi-Square test to test the significance of the independence of attributes. The significance of a test is validated at 5% level of significance and power of 80% having the effect size of 0.5, the desired samples size is 38. However, to improve the efficacy of the test and keeping other factors in view, we collected the sample size of 50. *P* Value <0.05 was considered significant.

Results

The study was carried out on 50 patients; 54% of the patients were males and 46% were females [Table 1]. The average age of the patients was 55 years with a standard deviation of 14.82 [Table 2]. The average weight of the patients was 72.22 kg with a standard deviation of 11.36 [Table 3]. Of the total 50 patients, 52% underwent TKR for primary osteoarthritis knee and 48% underwent THR for secondary osteoarthritis hip [Table 1]. For a total of 50 patients, 550 VAS responses (11 observations for each patient) were collected at various time intervals as mentioned above over a period of 72h postoperatively [Table 4]. The majority of the responses were mild, annoying pain (26.7%), followed by nagging, uncomfortable, troublesome pain (22.7%), and

Table 1: Demographic data

	No. of patients	% of patients
Gender of the patients		
Female	23	46.0
Male	27	54.0
Diagnosis of the patients		
Primary osteoarthritis knee	26	52.0
Secondary osteoarthritis hip	24	48.0
Type of surgery		
Total hip replacement	24	48.0
Total knee replacement	26	52.0

Table 2: Descriptive statistics of age of patients

No. of patients	Minimum	Maximum	Mean	Std. deviation	Skewness	Kurtosis
50	21	75	55.00	14.827	-0.926	0.090

Table 3: Descriptive statistics of weight of patients

No. of patients	Minimum	Maximum	Mean	Std. deviation	Skewness	Kurtosis
50	53	92	72.22	11.316	0.119	-1.197

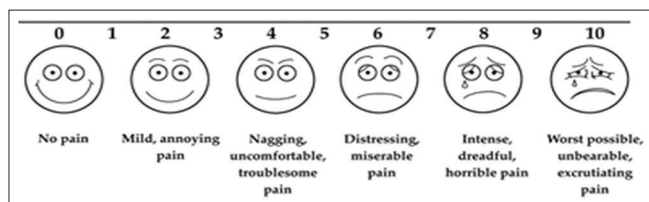


Figure 1: Visual analog pain score

no pain (22.0%). Not even a single patient complained of worst possible, unbearable, and excruciating pain. The overall trend showed that there was gradual increase in pain among all the 50 patients from the first hour (no pain) to fourth hour (nagging, uncomfortable, troublesome pain) and gradually decreased to mild, annoying pain by 72 h.

None of the patients complained of pruritis at any point of time during the observation period of 72 h postoperatively [Table 5]. Of the total 550 observations for 50 patients during an observation period of 72h, only 6 were noted as yes for nausea and vomiting [Table 6].

Of the total 550 observations for somnolence [Table 7] in 50 patients during period of observation of 72h, it was observed that 74% were fully awake irrespective of time except during the night time, followed by somnolent and responded to call (25.3%) and somnolent and no response to verbal stimulation (0.7%). It was observed that none of the patient required rescue analgesia in the first 2 h. During 72 h period of observation postoperatively, the maximum demand for rescue analgesia by patients (32%) was observed at 8th hour followed by at 4th hour (20%) and 12th hour (16%) subsequently [Table 8].

Discussion

Inadequate postoperative pain control may cause delay in recovery, prolonged hospital stay, delay in start of physiotherapy, and may even adversely affect the outcome of surgery.^[5] TDDS is a easy to use, non-invasive, safe, and reliable method of drug delivery. It allows continuous drug delivery and maintains sustained plasma levels of the drug. It also decreases the requirement of rescue analgesics by providing sustained pain relief and reducing the incidence of breakthrough pain. Due to slow and sustained release of drug, sudden increases in plasma drug levels are avoided, reducing the incidence of adverse effects associated with drugs.

Table 4: Distribution of patients' response to VAS

No. of patients/time	VAS										Total	
	0	1	2	3	4	5	6	7	8	9		10
1 h	21	4	18	1	5	0	1	0	0	0	0	50
2 h	16	4	9	3	18	0	0	0	0	0	0	50
3 h	12	4	10	4	12	1	7	0	0	0	0	50
4 h	9	3	11	3	10	1	8	1	4	0	0	50
8 h	4	5	10	4	16	2	5	0	4	0	0	50
12 h	5	5	17	2	13	2	5	0	1	0	0	50
16 h	8	3	13	3	14	1	8	0	0	0	0	50
20 h	7	6	15	1	15	0	6	0	0	0	0	50
24 h	11	7	9	4	9	0	10	0	0	0	0	50
48 h	11	9	18	2	5	0	5	0	0	0	0	50
72 h	17	9	17	1	5	0	1	0	0	0	0	50
Total no. of observations	121	59	147	28	122	7	56	1	9	0	0	550

VAS, Visual analog score

Table 5: Observation for pruritis

Time of observation	Pruritis (yes/no)		Total
	No.	Total	
1 h	50	50	
2 h	50	50	
3 h	50	50	
4 h	50	50	
8 h	50	50	
12 h	50	50	
16 h	50	50	
20 h	50	50	
24 h	50	50	
48 h	50	50	
72 h	50	50	
Total no. of observations	550	550	

Table 6: Observation for Nausea and Vomiting

Time of observation	Nausea and vomiting (yes/no)		
	No	Yes	Total
1 h	49	1	50
2 h	50	0	50
3 h	50	0	50
4 h	50	0	50
8 h	48	2	50
12 h	49	1	50
16 h	49	1	50
20 h	50	0	50
24 h	50	0	50
48 h	49	1	50
72 h	50	0	50
Total no. of observations	544	6	550

Table 7: Somnolence categories

	No. of patients/time			Total
	Fully awake	Somnolent and responds to call	Somnolent and no response to verbal stimulation	
1 h	35	14	1	50
2 h	34	16	0	50
3 h	39	11	0	50
4 h	42	8	0	50
8 h	43	6	1	50
12 h	30	20	0	50
16 h	34	15	1	50
20 h	41	9	0	50
24 h	41	8	1	50
48 h	34	16	0	50
72 h	34	16	0	50
Total no. of observations	407	139	4	550
% of responses	74%	24.3%	0.7%	100

Table 8: Rescue analgesia/VAS

No. of patients/time	VAS										Total
	0	1	2	3	4	5	6	8	9	10	
@1 h	50	0	0	0	0	0	0	0	0	0	50
@2 h	50	0	0	0	0	0	0	0	0	0	50
@3 h	46	0	1	0	1	0	2	0	0	0	50
@4 h	40	0	0	0	3	1	4	2	0	0	50
@8 h	34	1	3	1	2	2	4	3	0	0	50
@12 h	42	0	1	0	5	0	1	1	0	0	50
@16 h	48	0	1	0	0	0	1	0	0	0	50
@20 h	44	1	1	0	0	1	2	1	0	0	50
@24 h	41	0	0	0	0	0	9	0	0	0	50
@ 48 h	44	0	1	0	2	0	3	0	0	0	50
@72 h	47	0	0	0	0	0	3	0	0	0	50
Total no. of patients	486	2	8	1	13	4	29	7	0	0	550

VAS, Visual analog score

Buprenorphine patches have been used effectively for chronic low back pain and for pain associated with osteoarthritis.^[6-9]

In this study, we determined the effect of preoperative application of buprenorphine transdermal patch on analgesic requirement in postoperative period in hip and knee replacement surgeries. The use of continuous epidural analgesia during post-operative period may preclude early mobilization due to motor effects of local anesthetic drug. Use of transdermal buprenorphine patch in addition to continuous epidural infusion can even promote early tapering of epidural analgesia and reduce the requirement of opioid or non-opioid analgesics during mobilization and physiotherapy. During postoperative period after 8 h, patients were instructed to do toe movements and active quadriceps exercises. After 24 h, patients were shifted from postoperative recovery unit to their rooms or wards, and straight leg raising and gluteal muscle exercises were started for TKR and THR patients, respectively, thereafter. At 48 h, drain was removed and check X-ray was done in radiology

department. After 72 h, physiotherapy was started for TKR and THR.

We could manage postoperative analgesia in our study cases with preoperative application of buprenorphine transdermal patch of 10 mg (sustained release of 10 µg/h) and postoperative continuous epidural infusion of 0.125% bupivacaine at a rate of 4–5 mL/h without fentanyl or any other additives. Only inj. paracetamol 1g iv was given whenever required according to demand from patient irrespective of VAS score at that time. As the pain is a subjective feeling and tolerance to pain varies from patient to patient, we did not consider VAS score as criteria for providing rescue analgesia. Some patients required analgesic supplementation with even lower VAS score. We completely avoided postoperative use of opioid or any other analgesics through any route except iv paracetamol. Maximum demand (32%) of rescue analgesia in postoperative period among our study cases was observed at 8th hour, which corresponds to the time when patients are instructed to do toe movements and starting of active quadriceps exercises. Rescue analgesia demand by 20% patients at 4th hour may correspond to segment regression of spinal anaesthesia. Although it is drawback of our study that we did not monitor segment regression of spinal anaesthesia in postoperative period. No literature is available about use of transdermal buprenorphine patch in patients undergoing joint replacement surgery. Vittorio Emenule *et al.* studied the efficacy and safety of preoperative application of transdermal buprenorphine patch for postoperative pain management of elderly patients with proximal femoral fractures.^[10] They also found it effective with high patient satisfaction score. In another study by Conaghan *et al.*, transdermal buprenorphine patch and paracetamol were compared with codeine and paracetamol in elderly patients with osteoarthritis of the hip or knee joints and there was significantly less requirement of

escape medication in buprenorphine patch and paracetamol group when compared with other group.^[9]

Conclusion

Preoperative application of transdermal buprenorphine patch (10 mg) is effective for postoperative analgesia after hip and knee replacement surgeries. It reduces the requirement of postoperative rescue analgesics too. Further studies with greater sample size are required to prove its efficacy.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Budd K. Buprenorphine. In: Bullingham RES, editor. Clinics in anaesthesiology. London: WB Saunders Company Ltd; 1983. p. 147-52.
2. Evans HC, Easthope SE. Transdermal buprenorphine. *Drugs* 2003;63:1999-2010.
3. Arshad Z, Prakash R, Gautam S, Kumar S. Comparison between transdermal buprenorphine and transdermal fentanyl for postoperative pain relief after major abdominal surgeries. *J Clin Diagn Res* 2015;9:UC01-4.
4. Yadav M, Kumar P B, Singh M, Gopinath R. Intrathecal magnesium sulfate as a spinal adjuvant in two different doses, combined with 0.5% heavy bupivacaine for infraumbilical surgeries. *Anesth Essays Res* 2015;9:364-8.
5. Likar R. Transdermal buprenorphine in the management of persistent pain – Safety aspects. *Ther Clin Risk Manag* 2006;2:115-25.
6. Landau CJ, Carr WD, Razzetti AJ, Sessler NE, Munera C, Ripa SR. Buprenorphine transdermal delivery system in adults with persistent noncancer-related pain syndromes who require opioid therapy. *Clin Ther* 2007;29:2179-93. Erratum in *Clin Ther* 2009;31:677.
7. Gordon A, Rashiq S, Moulin DE, Clark AJ, Beaulieu AD, Eisenhoffer J. Buprenorphine transdermal system for opioid therapy in patients with chronic low back pain. *Pain Res Manag* 2010;15:169-78.
8. Munera C, Drehobl M, Sessler NE, Landau C. A randomized, placebo-controlled, double-blinded, parallel-group, 5-week study of buprenorphine transdermal system in adults with osteoarthritis. *J Opioid Manag* 2010;6:193-202.
9. Conaghan PG, O'Brien CM, Wilson M, Schofield JP. Transdermal buprenorphine plus oral paracetamol vs an oral codeine-paracetamol combination for osteoarthritis of hip and/or knee: A randomised trial. *Osteoarthritis Cartilage* 2011;19:930-8.
10. Privitera C, Guzzetta G. Transdermal (TDS) buprenorphine patches for postoperative pain management in orthopaedic surgery in the elderly. *Reg Anesth Pain Med* 2008;33:e187.

New features on the journal's website

Optimized content for mobile and hand-held devices

HTML pages have been optimized for mobile and other hand-held devices (such as iPad, Kindle, iPod) for faster browsing speed.

Click on [**Mobile Full text**] from Table of Contents page.

This is simple HTML version for faster download on mobiles (if viewed on desktop, it will be automatically redirected to full HTML version)

E-Pub for hand-held devices

EPUB is an open e-book standard recommended by The International Digital Publishing Forum which is designed for reflowable content i.e. the text display can be optimized for a particular display device.


Click on [**EPub**] from Table of Contents page.

There are various e-Pub readers such as for Windows: Digital Editions, OS X: Calibre/Bookworm, iPhone/iPod Touch/iPad: Stanza, and Linux: Calibre/Bookworm.

E-Book for desktop

One can also see the entire issue as printed here in a 'flip book' version on desktops.

Links are available from Current Issue as well as Archives pages.

Click on  View as eBook