



A prospective randomized comparative study of gelfoam soaked nalbuphine vs. ketamine placed in epidural space during lumbar spine surgery for postoperative analgesia

M. K. Giri¹, Vaibhav Singh¹, Prachi Pal², L. S. Mishra³, N. N. Gopal⁴

ABSTRACT

Background: Pain management is a major challenge after spine surgery. Parenteral opioids have been the mainstay of treatment for postoperative pain after lumbar spine surgeries. The biggest drawback of parenteral route is that drugs are given in large time gaps while ideal postoperative analgesia should provide continuous pain relief. Hence epidural route of analgesia has evolved as a critical component of pain management. We compared gelfoam soaked nalbuphine vs. ketamine placed in epidural space during lumbar spine surgery for postoperative analgesia.

Methodology: A prospective randomized, double-blind study of 60 patients of either sex between the age group of 18-60 years belonging to American Society of Anesthesiologists (ASA) grade I or II, posted for elective one or two segment laminectomy were included in the study. Patients were randomly allocated into three groups (20 patients each). In Group K gelfoam soaked in 50 mg of preservative free ketamine diluted with 5 ml normal saline was used. Group N patients received gelfoam soaked in 10 mg nalbuphine diluted with 5 ml normal saline and in Group C gelfoam soaked in 5 ml normal saline was placed in the epidural space just before wound closure.

Results: The total rescue analgesic (inj. Diclofenac sodium 75 mg) consumption in Group K was 90 ± 86.37 mg compared to 150 ± 91.04 mg in Group N ($p = 0.019$) and time of 1st analgesic requested was also significantly delayed in Group K compared to Group N ($p = 0.00048$). Visual analogue scale (VAS) scores were also lower in Group K during a period of 48 hours.

Conclusion: Epidural application of gelfoam soaked ketamine and nalbuphine both are effective method for maintaining postoperative analgesia, but ketamine shows better response in terms of lower pain scores and lesser rescue analgesic consumption than nalbuphine with lesser adverse effects.

Key words: Ketamine; Gelfoam; Nalbuphine; Epidural Space; Spinal surgery; Postoperative analgesia

Citation: Giri MK, Singh V, Pal P, Mishra LS, Gopal NN. A prospective randomized comparative study of gelfoam soaked nalbuphine vs. ketamine placed in epidural space during lumbar spine surgery for postoperative analgesia. *Anaesth Pain & Intensive Care* 2018;22(4):492-498

¹Assistant Professor;

²Postgraduate student;

³Professor,

Department of Anesthesiology,
MLN Medical College,
Allahabad 211002,
Uttar Pradesh, India.

⁴Professor,

Division of Neurosurgery,
Department of Surgery,
MLN Medical College,
Allahabad 211002,
Uttar Pradesh, India

Correspondence:

Dr Vaibhav Singh,
Department of Anesthesiology
and Critical Care, SRN Hospital
Campus, MLN Medical College,
Allahabad (U.P) - 211002 (India)

Phone no: +919919663368;

Email: drvaibhavsingh@gmail.com

Received: 9 Apr 2018

Reviewed: 14, 23 May 2018

Corrected & Accepted: 28 Dec 2018

INTRODUCTION

Effective postoperative pain control is an essential

component of postoperative care, and inadequate pain control may result in increased morbidity or mortality.^{1,2} Pain management can be a major

challenge after spine surgeries. Spine surgeries are mostly elective in nature and commonly performed surgeries include laminectomies, discectomies, spinal fusions, instrumentations, scoliosis corrections, and spinal tumor excision. Pain from the back originates from different tissues such as vertebrae, intervertebral discs, ligaments, dura mater, nerve root sleeves, facet joint capsules, fascia, and muscles. The intensity of postoperative pain is directly proportional to the number of vertebrae involved in the surgery.³ A variety of pain assessment tools can be utilized to quantify the pain in its different dimensions. The numerical rating scale and the visual analogue scale (VAS) are validated tools to quantify the intensity of pain.⁴ Modalities available for postoperative pain management include central neuraxial blockade with local anesthetics, high-dose parenteral opioids, epidural local anesthetics and opioids with or without adjuvants like clonidine, and non-steroidal anti-inflammatory agents.⁵ Parenteral opioids have been the mainstay of treatment for postoperative pain after lumbar spine surgeries.⁶ The biggest drawback of parenteral opioids is that drugs are usually given with relatively large time lapses, so there are wide fluctuations in clinical effect. Ideal postoperative analgesia should provide continuous pain relief, in an alert patient who can be mobilized early.⁷ Alternatively, we can use epidural administration of narcotics as a single dose at the time of the surgery, or via an epidural catheter post-operatively.⁸ Epidural catheters are difficult to manage and maintain after spine surgery.⁹ In addition, there is always a concern of infection, restricting its widespread application.¹⁰ To prolong the effect of epidural opioids, drugs can be given by soaking in gelfoam.^{11,12} Gelfoam is a sterile compressed sponge, water-insoluble in nature. It is a hemostatic device capable of absorbing up to 45 times its weight of whole blood.³ Ketamine is a non-competitive NMDA receptor antagonist. It inhibits central sensitization,¹⁴ thus providing the analgesia for surgical pain. Nalbuphine, a derivative of 14-hydroxymorphine is a strong analgesic with mixed κ agonist and μ antagonist properties.⁵ It also exhibits ceiling effect on respiratory depression. We planned this study to evaluate and compare the effectiveness of drugs, e.g. nalbuphine and ketamine in the form of soaked gelfoam used in spinal surgery for postoperative analgesia.

METHODOLOGY

This prospective randomized, double-blind study was conducted at Swaroop Rani Nehru Hospital associated with MLN Medical College, Allahabad

(UP), India. After approval from ethical committee and obtaining written and informed consent from the patients, the study was done over a period of one year.

A total of 60 patients of either sex, in the age group of 18-60 years, belonging to American Society of Anesthesiologists (ASA) grade I or II, posted for elective one or two segment laminectomy were included in the study.

Exclusion criteria included patient refusal, patients with pre-existing neurological, psychological, cardiac or respiratory system disease, patients with history of substance abuse. Patients with BMI >30, patients undergoing cervical or thoracic laminectomies and previous history of spine surgery were also excluded. Also excluded were patients who had accidental dural tear while undergoing laminectomy, or those unable to comprehend visual analogue scale (VAS).

We started our study with 66 patients who were posted for lumbar laminectomy, 6 patients were excluded before administration of study drugs due to various reasons. So, 60 patients were included and completed the study, 20 in each group (Figure 1). All patients were explained about visual analogue scale (VAS) the day before surgery and counseled.

A standardized protocol for general anesthesia was followed for all the patients. The study drugs were prepared by an anesthesia resident who did not participate in the study and handed over to the surgeon. Patients were randomly allocated into three groups (20 patients each) by computer generated sequence of random numbers.

Group K - received 5 × 1 cm gelfoam soaked in 50 mg of preservative free ketamine diluted with 5 ml normal saline.

Group N- received 5 × 1 cm gelfoam soaked in 10 mg nalbuphine diluted with 5 ml normal saline.

Group C- received 5 × 1 cm gelfoam soaked in 5 ml normal saline placed in epidural space, just before closure.

Postoperative pulse rate, blood pressure and oxygen saturation were recorded and patient was shifted to post anesthesia care unit (PACU) where continuous monitoring was carried out. In PACU, all patients were supported with supplemental oxygen for first 2 h. After this time, oxygen was administered only if saturation dropped below 94%.

Following parameters were recorded:

1. Heart rate (HR)- rate of 50-100 bpm was taken as optimal range for this study, <50 bpm was considered as bradycardia, and inj. atropine 0.6 mg was given.

gelfoam soaked nalbuphine vs. ketamine placed in epidural space

Table 1: Demographic data

Parameter	Group N	Group K	Group C	P value
Age (years)	39.2 ± 9.865	41.8 ± 8.989	42.25 ± 7.623	0.506
Weight (kg)	61.2 ± 4.927	62.45 ± 4.334	61.2 ± 4.572	0.616
Sex (male:female)	10:10	11:9	12:8	0.818

($p < 0.05$ was considered significant)

Table 2:- No. of segment involved in laminectomy

Laminectomy	Group N	Group K	Group C	P value
One Segment	12	9	13	0.414
Two Segment	8	11	7	

($p < 0.05$ was considered significant)

Table 3 - Visual Analogue (VAS) Scores

Time Interval	Nalbuphine	Ketamine	Control	p value
T2H	0.1 ± 0.447	0	0.3 ± 0.470	P1 .161 P2 .088 P3 .003*
T4H	0.25 ± 0.910	0.1 ± 0.447	1.85 ± 1.565	P1 .256 P2 .00016** P3 .00012**
T6H	0.25 ± 0.5501	0.15 ± 0.6708	3.2 ± 1.852	P1 .304 P2 .00001** P3 .00001**
T10H	1.3 ± 1.75	0.5 ± 1.317	4.3 ± 1.78	P1 .055 P2 .00001** P3 .00001**
T14H	2.56 ± 2.64	0.6 ± 0.88	4.2 ± 2.015	P1 .00107* P2 .0218* P3 <.00001**
T18H	2.75 ± 2.07	1.65 ± 1.46	3.65 ± 1.66	P1 .029* P2 .069 P3 .00012*
T22H	2.9 ± 1.88	2.25 ± 1.802	5.3 ± 2.27	P1 .136 P2 .00041** P3 .000017**
T30H	4.25 ± 2.53	3.05 ± 1.66	5.75 ± 2.36	P1 .0423* P2 .030* P3 .00008**
T38H	3.95 ± 2.08	3.65 ± 1.53	6.2 ± 2.46	P1 .3037 P2 .0017* P3 .00017**
T48H	4.3 ± 2.105	3.3 ± 1.719	5.5 ± 2.704	P1 .054 P2 .0628 P3 .00197**

- Mean arterial pressure (MAP) - if < 65 mmHg, inj. mephentermine 6 mg was given as a bolus.
- Respiratory rate (RR) - 11-16 per minute was

taken as optimal range here, RR < 10 per min was considered as respiratory depression and supplemental oxygen was given if saturation fell below 92%.

4. VAS - patients were already familiarized with VAS preoperatively. In postoperative period they were asked about subjective pain. They were also asked about location of pain and its association with movement.

5. Rescue analgesic- patients were administered supplemental rescue analgesic with inj. diclofenac 75 mg IV bolus if VAS was > 3 which could be repeated after 20 min if required.

Opioids and all other analgesic or anti-inflammatory agents except inj. diclofenac were prohibited for the first 48 h after study dose. After 48 h, alternate opioid therapies were permitted at the investigator's discretion. Naloxone was permitted for opioid related side effects.

The duration of pain relief was defined as the time from the end of the operation until the patient request for supplementation of analgesic. Time of first demand of analgesic and total analgesic consumption in the initial 24 and 48 h were recorded.

6. Level of sedation was assessed by Ramsay Sedation Scale.¹⁶

7. Time of ambulation - patients were encouraged to ambulate 6 h after surgery if they felt comfortable. Time of ambulation was counted from the time to shift to PACU until the time patients could be ambulated, later patients were discharged from PACU to ward if modified Aldrete's score¹⁷ was ≥ 9 , patient had voided urine and started accepting orally. Time of discharge was noted and pulse oximetry monitoring continued in ward for 48 h.

Different complications in all 3 groups were noted. All the parameters were recorded hourly for the first 6 h, after that at 2 hourly intervals till 12 h and at 4 hourly intervals till 48 h by the resident anesthesiologist, who was unaware of the group allocation.

Statistical analysis: Data were analyzed using statistical package of social sciences (SPSS, version

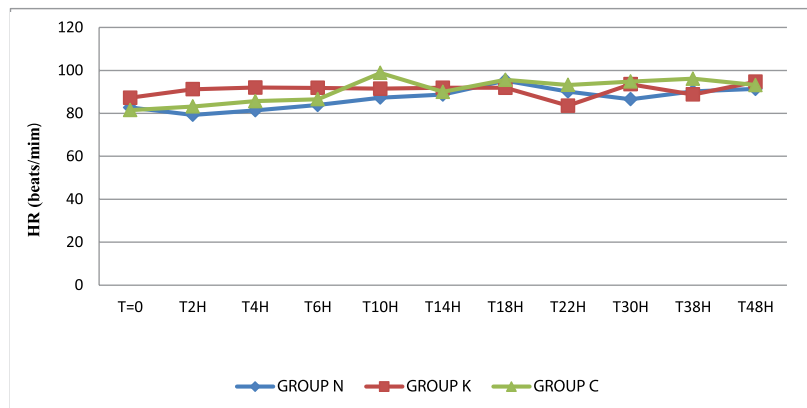


Figure 1: Comparative mean heart rate at different times

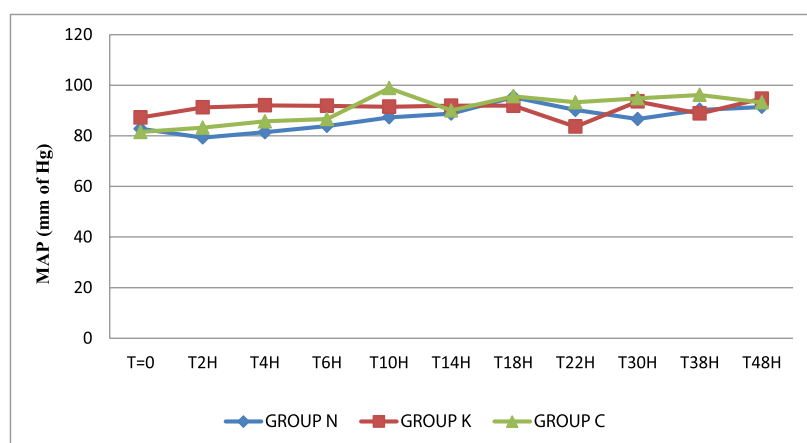


Figure 2: Comparative mean arterial pressure at different times

19) software and expressed as mean \pm standard deviation. Continuous data were analyzed using ANOVA test. Inter group and intra group comparison was done using paired *t*-test for numeric data. Control group was at power of 0.8, confidence interval of 95% was defined using software PS 3.1.2, *p*-value < 0.05 was considered as statistically significant.

RESULTS

Patients of all three groups were statistically comparable regarding mean age, weight, gender, ASA physical status and surgical characteristics (Table 1). Patients were also comparable in all three groups for number of segments involved for laminectomy ($P=0.414$) (Table 2).

Mean HR values were significantly lower in Group N up to 14 h, after that HR increased significantly in Group N compared to Group K. No incidence of bradycardia was observed during study. In Group C mean HR values significantly increased after 10 h and remained high throughout the study (Figure 1)

Regarding changes in MAP on inter-group comparison

values were comparable in all 3 groups, statistically no significant difference was observed in postoperative period (Figure 2)

Regarding RR changes, mean values were significantly lower in Group N and Group K up to initial 14 h, after that mean RR in Group N was significantly increased. No incidence of respiratory depression was observed. Group C mean RR values remained high through the study.

VAS scores in Group K and Group N were significantly lower compared to Group C at most of the time interval, while Group K VAS scores were lower than Group N from 10 h to 30 h of study period (Table 3). Time of 1st analgesic requested was significantly prolonged in Group N compared to Group C, and in Group K compared to both other groups. Analgesic requested by patients of Group C was 26 h and 10.9 h earlier than Group K and Group N respectively. Total analgesic consumption in Group C was 3.6 times in Group K and 2.24 times in Group N which shows significantly reduced ($p < 0.05$) consumption by patients of Group K, thus proving Ketamine to be most effective in postsurgical pain control (Table 4).

In our study 85% patients in Group N and 65% in Group K requested for rescue analgesic, while it was 100% in Group C.

Time of ambulation after surgery was significantly earlier in Group K and Group N compared to Group C, but it was earlier in Group K. Thus patients of ketamine group were able to ambulate earlier due to effective pain control. While no significant difference was observed in time to discharge among the groups (Table 4). Regarding side effects observed due to the use of study drugs nausea, vomiting, and sedation were comparable in all the groups with statistically no significant difference. No incidence of respiratory depression were observed among the groups; however, incidence of urinary retention and pruritus was significantly higher in nalbuphine group 8(40%) patients and 6(30%) patients respectively, while none observed in Group K and Group C (Table 5).

gelfoam soaked nalbuphine vs. ketamine placed in epidural space

Table 4: Postoperative analgesic requirement, time of ambulation and discharge

Parameters	Group N	Group K	Group C	p value
Time of 1 st analgesic requirement (hours)	19.7 ± 13.56	34.8 ± 13.14	8.8 ± 3.13	P1= 0.00048** P2 =0.0006** P3 < 0.00001**
Total analgesic consumption (mg) in form of inj. diclofenac sodium 75 mg i.v.	150 ± 91.04	90 ± 86.37	277.5 ± 60.09	P1=0.019* P2 < 0.00001** P3 < 0.00001**
Time of ambulation (hours)	6.05 ± 0.759	5.55 ± 0.759	7.5 ± 0.827	P1= 0.022* P2 < 0.00001** P3 < 0.00001**
Time of discharge (days)	2.9 ± 0.55	2.7 ± 0.47	2.95 ± 0.51	P1= 0.112 P2 =0.383 P3=0.057

Table 5: Postoperative side effects

Side Effect	Group N	Group K	Group C	p value (p < 0.05)*
Nausea	9 (45%)	3 (20%)	6 (30%)	0.223
Vomiting	6 (30%)	1 (5%)	4 (20%)	0.177
Respiratory depression	0	0	0	-
Sedation	4 (20%)	7 (35%)	1 (5%)	0.12
Urinary retention	8 (40%)	0	0	0.0003**
Pruritus	6 (30%)	0	0	0.002*

DISCUSSION

Ideally postoperative analgesia should be continuous,⁷ which is not so easy in the case of parenteral route. Thus epidural analgesia has evolved as a critical component of multimodal approach and offers superior postoperative pain relief.

Thus routine use of surgical gelfoam in the epidural space at the completion of surgery encouraged many studies to use it as extended release drug delivery system to prolong the effect of epidural analgesics. Gibbons KJ et al.¹⁸ conducted a study with 45 patients posted for lumbar discectomy, using 40-80 mg methylprednisolone acetate soaked gelfoam injected with 2 to 4 mg of preservative-free morphine. He observed that only 60% patients on the day of surgery and 51% on 1st postoperative day requested for supplemental analgesia. Similar study done by Movasaghi R et al.¹⁹ with 100 patients found that supplemental analgesic (morphine) consumption was 10.75 mg in study group and 21.4 mg among control group patients (p < 0.0001). He also found that patients of study group (steroid + morphine) patients ambulate at 2 days and discharged on 4.7 days while control group (steroid) patients ambulate at 2.6 days and discharged on 6 days (p < 0.0001). In our study 25% patients in ketamine group while 65% patients in nalbuphine group requested for rescue analgesic in

1st 24 h, while patients were discharged earlier at 2-3 days.

Mishra LD et al.²⁰ used 0.3 mg buprenorphine soaked gelfoam in 30 patients and observed duration of analgesia of 14.8 ± 0.77 h which is less than in duration for (19.7 ± 13.56 h with 10 mg gelfoam soaked Nalbuphine and 34.8 ± 13.14 hours with 50 mg gelfoam soaked ketamine) drugs used in our study.

Kundra S et al.²³ observed a significantly prolonged duration of analgesia of 30.03 ± 6.796 h; in our study a longer duration of 34.8 ± 13.14 h was observed with use of gelfoam soaked ketamine. Rescue analgesic (inj. diclofenac sodium) consumed in our study in nalbuphine group

was 1.7 times more than ketamine group, while in their study 3.5 times more and 20 h earlier in control group compared to morphine study group. VAS scores were lower in Group K of our study concluding that patients in ketamine group were most pain free in comparison to nalbuphine and control group, hence ketamine provides most effective analgesia among study drugs.

Another researcher²¹ used absorbable gelatin sponge soaked in 0.1 ml of preservative free morphine (1 mg) diluted in 3 ml of normal saline followed by placement of another layer of gelfoam to prevent aspiration of the morphine in the drains, but no significant difference regarding VAS scores was observed when compared to PCA system of 5 mg/ml of morphine used in other group. So we can say that VAS scores were not significantly affected with the use of gelfoam, However, further studies are required in this context. A similar recent study using gelfoam soaked morphine was conducted by Hassanein A et al.²⁴ with 75 patients. He found that using colloid (6% HES) as a diluent significantly prolongs the duration of analgesia up to 43.04 ± 2.13 h compared to 38.04 ± 2.05 h with the use of crystalloid. The dose of Nalbuphine used in our study corresponds to the dose used in earlier studies.^{25,26}

Regarding side effects nausea/vomiting was higher in nalbuphine group while sedation was higher in ketamine group, but the difference was not statistically significant ($p > 0.05$). However, itching and urinary retention was significantly high in nalbuphine group with ($p = 0.002$) and ($p = 0.0003$) respectively.

CONCLUSION

Epidural application of gelfoam soaked ketamine and nalbuphine both are effective for maintaining postoperative analgesia, but ketamine shows better response in terms of lower pain scores and lesser rescue analgesic consumption than nalbuphine with

lesser adverse effects. Hence, epidural gelfoam soaked ketamine can be effectively used for postoperative pain management in patients undergoing lumbar laminectomy.

Source of Support: Nil

Conflict of Interest: None declared

Authors' contribution:

MKG: Conduction of study work and literature research

VS: Design of study and manuscript editing

PP: Study analysis and literature research

LSM: Conduction of study work and statistical analysis

NNG: Design of study and literature research

REFERENCES

- Sharrock NE, Cazan MG, Hargett MJ, Williams-Russo P, Wilson PD Jr. Changes in mortality after total hip and knee arthroplasty over a ten-year period. *Anesth Analg.* 1995;80:242–8. [PubMed]
- Katz J, Jackson M, Kavanagh BP, Sandler AN. Acute pain after thoracic surgery predicts long-term post-thoracotomy pain. *Clin J Pain.* 1996;12(1):50–5. [PubMed]
- Bernard JM, Surbled M, Lagarde D, Trenec A. Analgesia after surgery of the spine in adults and adolescents. *Cah Anesthesiol.* 1995;43:557–64. [PubMed]
- D. Gould, Kelly D, Goldstone L, Gammon J. Examining the validity of pressure ulcer risk assessment scales: developing and using illustrated patient simulations to collect the data. *J Clin Nurs.* 2001;10(5):697-706. [PubMed]
- Kehlet H. Modification of response to surgery and anaesthesia by neural blockade: clinical implications. In: Cousins MT, Bridebaugh PO, editors. *Neural Blockade in Clinical Anaesthesia and Management of Pain.* 3rd ed. Philadelphia: Lippincott; 1998.
- Raw DA, Beattie JK, Hunter JM. Anaesthesia for spinal surgery in adults. *Br J Anaesth.* 2003;91:886–904. [PubMed]
- Coşar A, Daneyemez M, Kurt E, Bilgin F, Canakçi Z, Gezen F, et al. Pain control following lumbar laminectomy: comparison of epidural morphine and morphine plus bupivacaine. *Turk Neurosurg.* 1999;9:64–7. [Free Full Text]
- Bourke DL, Spatz E, Motara R, Ordia JI, Reed J, Hlavacek JM. Epidural opioids during laminectomy surgery for postoperative pain. *J Clin Anesth.* 1992;4:277–81. [PubMed]
- Kluba T, Hofmann F, Bredanger S, Blumenstock G, Niemeyer T. Efficacy of post-operative analgesia after posterior lumbar instrumented fusion for degenerative disc disease: A prospective randomized comparison of epidural catheter and intravenous administration of analgesics. *Orthop Rev (Pavia).* 2010;2(1):e9. [PubMed] DOI: [10.4081/or.2010.e9](https://doi.org/10.4081/or.2010.e9)
- Bajwa SJ, Kulshrestha A. Spine surgeries: challenging aspects and implications for anaesthesia. *J Spine Neurosurg.* 2013;2:3. [Free Full Text].
- Gibbons KJ, Barth AP, Ahuja A, Budny JL, Hopkins LN. Lumbar discectomy: use of an epidural morphine sponge for postoperative pain control. *Neurosurgery.* 1995;36:1131–5. [PubMed]
- Mishra LD, Nath SS, Gairola RL, Verma RK, Mohanty S. Buprenorphine-soaked absorbable gelatin sponge: an alternative method for postlaminectomy pain relief. *J Neurosurg Anesthesiol.* 2004;16:115–21. [PubMed]
- Jenkins HP, Senz EH, Owen H, Jampolis RW. Present status of gelatin sponge for control of hemorrhage. *J Am Med Assoc.* 1946;132:614-9. [PubMed] DOI: [10.1001/jama.1946.02870460004002](https://doi.org/10.1001/jama.1946.02870460004002)
- Weinbroum AA. A single small dose of postoperative ketamine provides rapid and sustained improvement in morphine analgesia in the presence of morphine-resistant pain. *Anesth Analg.* 2003;96:789–95. [PubMed]
- Gunion MW, Marchionne AM, Anderson TM. Use of the mixed agonist-antagonist nalbuphine in opioid based analgesia. *Acute Pain.* 2004;6:29–39
- Ramsay MA, Savege TM, Simpson BR, Goodwin R. Controlled sedation with alphaxalone-alphadolone. *Br Med J.* 1974;2(5920):656–9. [PubMed]
- Aldrete JA. The post-anaesthesia recovery score revisited. *J Clin Anesth.* 1995;7:89–91. [PubMed]
- Gibbons KJ, Barth AP, Ahuja A, Budny JL, Hopkins LN. Lumbar discectomy: use of an epidural morphine sponge for postoperative pain control. *Neurosurgery.* 1995;36(6):1131–5. [PubMed]
- Movasaghi R, Salehpour F, Ahmadvand A, Agha-Mohammadi D, Dorosty A, Vafae R. The effect of epidural morphine sponge in postoperative pain control after microdiscectomy. 2012;3(4):7-11. [Free Full Text]
- Mishra LD, Nath SS, Gairola RL, Verma RK, Mohanty S.

gelfoam soaked nalbuphine vs. ketamine placed in epidural space

- Buprenorphine-soaked absorbable gelatin sponge: an alternative method for postlaminectomy pain relief. *J Neurosurg Anesthesiol.* 2004;16:115–21. [PubMed]
21. Saoud K, Sabry H, Ramzy O. Comparison of epidural morphine soaked gel foam and continuous intravenous morphine using PCA in the management of postoperative pain following lumbar spinal fixation surgery. *Egyptian J Neurosurg.* 2014;29(3):67-72. [Free Full Text]
22. Gamli M, Dalgic A, Ornek D, Horasanli E, Kilci O, Un C, et al. Evaluation of The efficacy of bupivacaine soaked in Gelfoam® at the iliac crest bone graft site. *Rev Bras Anesthesiol.* 2012;62(6):811-8. [PubMed] DOI: [10.1016/S0034-7094\(12\)70181-2](https://doi.org/10.1016/S0034-7094(12)70181-2)
23. Kundra S, Gupta V, Bansal H, Grewal A, Katyal S, Choudhary AK. Comparative study of epidural application of morphine versus gelfoam soaked in morphine for lumbar laminectomy. *J Anaesthesiol Clin Pharmacol.* 2014;30(1):46–52. [PubMed] DOI: [10.4103/0970-9185.125703](https://doi.org/10.4103/0970-9185.125703)
24. Hassanein A, Ali NS, Saad A. Colloid versus crystalloid soaked gelfoam with morphine for postoperative pain relief after lumbar laminectomy. *Egypt J Anaesth.* 2016;32(4):495-502. DOI: [10.1016/j.egja.2016.08.019](https://doi.org/10.1016/j.egja.2016.08.019)
25. Etches RC, Sandler AN, Lawson SL. A comparison of the analgesic and respiratory effects of epidural nalbuphine or morphine in postthoracotomy patients. *Anesthesiology.* 1991;75:9–14. [PubMed]
26. Subramaniam K, Subramaniam B, Pawar DK, Kumar L. Evaluation of the safety and efficacy of epidural ketamine combined with morphine for postoperative analgesia after major upper abdominal surgery. *J Clin Anesth.* 2001;13(5):339–44. [PubMed]

Facebook Pages by Apicare Journal

Research Proposals

With a total page likes at 2313 and 2,360 follows, Research Proposals strives to create interest in research, by posting everything related to research and research methodology in a single forum. The page also offers some easy-to-perform research proposals to the novices. The links to various research related online resources are also posted. Visitors are encouraged to post more and more proposals for the benefit of our research starved specialties.



Anesthesia Books & Journals

This page is intended for the latest information about current medical books and journals. Viewers can post freely the pictures of the title and links. Total page followers are 8,402, and total page likes as of today are 8,238. The page offers links to downloadable books about anesthesiology, pain, intensive care, resuscitation as well as basic medical subjects of interest. The books or booklets pertaining to the examinations and exam preparation for anesthesiology, pain management or intensive care are also offered. The readers can send links

to full length books etc. to be uploaded on the page. It's a valuable resource for anyone interested in these subjects.

Airway Management

Airway Management is a favorite page of anesthesiologists and intensivists the world over. It offers latest news, stories and pictures about airways and airway management. Someone very rightly said, "Anesthesia is nothing but airway management". The page has more than 4200 likes and 4135 followers from all around.

