Preemptive Segmental Epidural Levobupivacaine Administration and Wound Infiltration Following Posterior Fusion Surgery: A Case Serie

Posterior Füzyon Cerrahisi Sonrası Preemptif Segmental Epidural Levobupivakain Uygulaması ve Yara Yeri İnfiltrasyonu: Vaka Serisi

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ABSTRACT Objective: The current study aimed to provide intraoperative smooth wake-up test and postoperative effective analgesia by segmental epidural analgesia and wound infiltration in patients undergoing posterior fusion surgery. **Material and Methods:** Fifteen ASA I-II adolescent patients aged 11-16 undergoing posterior fusion and instrumentation were included to the study. After general anesthesia with standard intravenous anesthesia, epidural catheter was inserted to all patients in lateral decubitus position. Following confirmation of the place of the catheter under scopy, initially 3-4 ml of prepared mixture was administered from the catheter and then the catheter was retracted and during retraction, 1-2 mL of the mixture was given to each segment. Neuromonitorization was achieved with motor evoked potential (MEP). Postoperative pain was evaluated with visual analogue scale (VAS). Paracetamol infusion and nonsteroidal antiinflammatory analgesics were given for routine postoperative pain management. Intravenous patient-controlled analgesia with morphine was prepared to be given in case of VAS score higher than 40. **Results:** In all patients effective analgesia was achieved for postoperative 24 hours. No side effects and hemodynamic impairment were observed. The highest pain scores were obtained at the postoperative 12th hour and during movement. There was no requirement for morphine patient controlled anesthesia (PCA) as VAS values were lower than 40. The sleep quality of patients and the patient satisfaction were very good in all patients. **Conclusion:** Segmental epidural analgesia with a preoperatively placed epidural catheter and wound infiltration is a simple and reliable method for effective pain control in posterior fusion and instrumentation surgery in patients with adolescent idiopathic scoliosis.

Key Words: Levobupivacaine; analgesia, epidural; scoliosis; anesthesia, local

ÖZET Amaç: Çalışmanın amacı, posterior füzyon cerrahisi uygulanan hastalarda preemptif segmental epidural analjezi ve yara yeri infiltrasyonu ile intraoperatif yumuşak wake-up testi ve etkin postoperatif analjezi sağlamaktır. **Gereç ve Yöntemler:** Posterior füzyon ve enstrümentasyon uygulanacak 15 ASA I-II adolesan hasta (11-16 yaş aralığında) çalışmaya dâhil edildi. Standart intravenöz anestezi̇klerle genel anestezi uygulanmasının ardından tüm hastalara lateral dekübit pozisyonda epidural kateter yerleştirildi. Skopi altında kateter yerinin doğrulanmasını takiben hazırlanan karışımdan ilk olarak 3-4 ml verildi ve daha sonra kateter çekilerek her segmente 1-2 ml verildi. Nöromonitörizasyon motor uyarılmış potansiyel (MEP) ile sağlandı. Postoperatif ağrı, visual analog skalası (VAS) ile değerlendirildi. Rutin ağrı tedavisi için parasetamol infüzyon ve nonsteroid-antiinflamatuar ilaçlar verildi. VAS skoru 40'ın üzerinde olması durumunda morfin ile intravenöz hasta-kontrollü analjezi uygulanması planlandı. **Bulgular:** Tüm hastalarda 24 saat boyunca etkin analjezi sağlandı. Herhangi bir yan etki ve hemodinamik bozukluk gözlenmedi. En yüksek ağrı skorları postoperatif 12 saatte ve hareketle gözlendi. VAS değerleri 40'ın altında olduğu için hiçbir hastada morfin hasta kontrollü anestezi (PCA) gereksinimi olmadı. Hastaların uyku kalitesi ve hasta memnuniyeti çok iyi olarak bulundu. **Sonuç:** Posterior füzyon ve enstrümentasyon uygulanacak adolesan idiopatik skolyoz hastalarında, preoperatif yerleştirilen epidural kateter ile segmental epidural analjezi ve yara yeri infiltrasyonu, etkin ağrı kontrolü sağlamada basit ve güvenilir bir yöntemdir.

Anahtar Kelimeler: Levobupivakain; analjezi, epidural; skolyoz; anestezi, lokal

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Inspite of new developments in postoperative pain modalities, the pain following adolescent idiopathic scoliosis (AIS) surgery still remains as a challenging problem. Deep somatic pain and muscle spasm developing after posterior instrumentation causes severe pain that necessitates long-term effective analgesia.[1,2]

Although the effectiveness and reliability of epidural analgesia have been demonstrated in orthopedic surgery for many years, their use in postoperative pain management following AIS has been delayed.[3] The continuous use of epidural local anesthetics and opioids following AIS, was first practicised with single catheter, however inadequacy of single catheter technique in analgesia of such a large surgical field and additional high dose opioid requirements and thus development of opioid-related side effects have directed the investigators to place two catheters to the epidural space.[4-6] Concordantly Tobias et al. developed double catheter technique.[7] However epidural catheter technique may lead to postoperative infections and it is difficult to diagnose a neurological damage.[8]

Today the recommended method in postoperative pain management following AIS is a multimodal approach combining regional techniques, systemic opioid administration and simple analgesics.[9,10] However side effects of opioids and nonsteroidal-antiinflammatory drugs (NSAID) has lead clinicians to use "regional techniques" instead of these agents. In the current study; we aimed to evaluate the effects of multimodal analgesia with preemptive segmental epidural analgesia+ wound infiltration+NSAID on intraoperative wake-up characteristics and postoperative recovery characteristics following AIS.

MATERIAL AND METHODS

After obtaining written informed consent, fifteen patients with AIS undergoing posterior fusion surgery were included to the study. A full preoperative neurological and radiological examination was done. Patients with neurological impairment, cognitive dysfunction, who have scoliosis with large cobb angle (>50°) and including more than 7-8 segments and who have local anesthetic and morphine allergy were excluded.

A pilot study including three patients was performed to determine whether epidural analgesia affects MEP measurements or not. Basal MEP measurements were performed before administration of epidural local anesthetic and MEP measurements were repeated before correction of deformity and stretching the rods and it was observed that motor block that is thought to be caused by epidural local anesthetic administration, was minimal or disappeared. So we thought that epidural analgesia had no effect on MEP measurements.

Before operation, all patients were informed about the details of wake-up test, Visual Analogue Scale (VAS) and possible side effects of the procedure and also they were informed that they will be transferred to the postoperative care unit (PACU). The patients were put in supine position and routine monitorization (electrocardiogram, blood pressure and saturation) and Bispectral index monitoring (BIS) (Aspect medical Systems, USA) were performed and intravenous access was achieved. All patients were informed about wake-up test again before induction. They were told to make "step on the brake" movement and to move their legs to the right and to the left when the command was given and they were told that they will be awake during this procedure but no pain will be felt.

For anesthesia induction, intravenous (IV) lidocaine 40 mg (2%), propofol 2-3 mg/kg and rocuronium bromide 0.6 mg/kg IV were administered and according to hemodynamic findings of the patients remifentanil was administered at a dose of 0.2-0.5 μg/kg. Anesthesia maintanence was achieved with propofol (200 μg/kg/min) and remifentanil (0.5 μg/kg/min). Hemodynamic and BIS values were continuously monitorized throughout the operation and the doses were arranged according to BIS values (to keep BIS value between 40 and 60) and hemodynamic parameters (To achieve a mean arterial pressure above 60 mmHg) during the operation.

All patients were put into lateral decubitus position and cobb angles were examined before the procedure and they were supported with pillows according to the curve of the vertebra. The level of the operation and the epidural approach were determined. As the intervention level not exceeding 6-7 segments were included to the study, epidural injection was planned at a single level and epidural catheter was inserted from the lowest intervertebral space of the operation field (T11-12 or L1-L2 level) and directed cephalad. The place of the radioopaque catheter was confirmed under scopy. The catheters which changed direction or which was inserted with difficulty were removed and directed again. Unsuccessful cases were excluded from the study. After confirmation of the catheter position, initially 3-4 mL of prepared mixture (1 mg morphine and 10 mL levobupivacaine 0.5% diluted in in a total of 20 mL of saline) was administered and then the catheter was retracted and during retraction, 1-2 mL of the mixture was given to each segment and the catheter was removed.

In all patients, neuromonitorization was achieved with motor evoked potential (MEP) and wake-up test was performed during the operation at least once. Muscle relaxant was given only at induction and no additional muscle relaxant was required. During basal MEP measurement, anesthesia was maintained with propofol and remifentanil, no additional muscle relaxant was given and the basal measurements were not affected. MEP measurements were performed by a professional team. At the end of the operation, before skin closure, the surgical team performed wound infiltration with 10 mL of levobupivacaine diluted in 10 mL of serum physiologic solution (total 20 mL). Then intravenous anesthetic agents were stopped. Following extubation, all patients were kept in the operation room until achieving recovery criterias. Following recovery, early sensorial and motor neurological examination was done by a person who was blinded to the study. All patients were transferred to the PACU and received a single dose of intramuscular NSAID (diclofenac sodium, Diclomec) 75 mg and 1 g of paracetamol by intravenous route for routine pain management. After the patients completely recovered, heated and early stage agitation was stopped, the pain was assessed with visual analogue scale (VAS) rating between 0 and 100 mm, by a nurse who was blinded to the study. The time of first interrogation was accepted as "0". Other interrogation periods were determined according to this. Intravenous morphine patient controlled anesthesia (PCA) (Bodyguard-575, Tarmed Mühendislik ve Medikal, Ankara, Turkey) was prepared so as to start when VAS scores exceed 40. Side effects (nausea-vomiting, itching, restlessness, insomnia and urinary retention) were recorded. PCA was arranged so as to give 1 mg of morhine as a bolus dose with a 30 minutes' of lockout period.

Neurological examination was done in every hour for the first postoperative 6 hours and then in four hours' intervals at PACU. The sleep quality of patients in 24 hours and the patient satisfaction was evaluated with Likerts scale as very bad=1, bad=2, undecided=3, good=4, very good=5. At the end of 24 hours' PACU stay, the patients were transferred to the ward.

Statistical Package for Social Sciences (SPSS for Windows, Chicago,IL,USA) version of 14.0 was used for data analysis. As there is only one study group, descriptive analyses were performed. Numerical variables were expressed as mean +/- standart deviation and categorical variables were expressed as percentages.

RESULTS

Demographical characteristics of the patients were demonstrated in Table 1.

The hemodynamic parameters were within normal limits in all time intervals. There was no requirement for blood transfusion in any patient.

Lying in supine position at early postoperative period has caused additional discomfort for all patients however required no additional treatment. Sufficient analgesia was obtained in all patients and median values of VAS scores at postoperative 1st, 2nd, 4th, 6th, 12th and 24th hours were lower than 40

and there was no need for intravenous morphine PCA (Table 2). There was no additional analgesic requirement. The highest VAS scores were at the 12th hour and it was achieved with movement.

No neurological injury and local anesthetic toxicity were observed during postoperative period. Sleep quality was found as good in all patients. The satisfaction was "very good" in all patients.

DISCUSSION

It was demonstrated that sufficient postoperative analgesia was achieved by using a multimodal approach including segmental epidural analgesia with single dose of levobupivacaine-morphine mixture, wound infiltration with levobupivacaine and single dose NSAID and paracetamol infusion in posterior instrumentation and stabilization surgery. Although at the present time, epidural opioid and local anesthetic infusions, IV PCA techniques, intermittant NSAID and paracetamol administrations are being used in postoperative pain management of patients undergoing surgery for AIS, there is no consensus on this subject yet.[9,11,12]

TABLE 1: Demographical characteristics.

	Values
Number of patients	15
Age (year) (mean±SD) (min-max)	13.7±1.9 (11-17)
Height (cm) (mean±SD) (min-max)	156.9±8.2 (143-170)
Weight (kg) (mean±SD)	52.4±8.3 (43-72)
Male/Female	5/10
Duration of operation (min)	183±18
Duration of anesthesia (min)	208±20
Total propofol consumption	927±185
Total remifentanil consumption	1970±432

TABLE 2: Postoperative mean pain scores and maximum pain scores at rest, during movement, during stepping on.

	VAS score (100)	
Postoperative hour	at rest	at movement
0th	0 (0-20)	0 (0-30)
1st	0 (0-20)	0 (0-30)
2nd	0 (0-20)	0 (0-30)
4th	0 (0-20)	0 (0-30)
6th	0 (0-20)	0 (0-30)
12th	20 (0-40)	30 (0-40)
24th	20 (0-40)	20 (0-40)

Values were represented as median (min-max).

In several studies it was reported that continuous local anesthetic and opioid infusion with epidural catheter provides better analgesia than intravenous analgesia.[11,12] In the present study, by providing preemptive analgesia with epidural levobupivacaine and morphine, we achieved low pain scores and perfect patient satisfaction in all patients. In another study by Mamik et al, it was demonstrated that preemptive epidural segmental analgesia has provided better pain relief than intravenous patient controlled analgesia. In the prementioned study, the level of intervention was large so in cases where a single catheter was thought to be insufficient, they placed a second epidural catheter from another level and directed it in opposite direction of the first catheter and administered the same mixture to that level also.[13] However in the present study we included the patients with limited number of intervention level so a second catheter wasn't required. Another advantage of this segmental technique is that it is possible to wake up the patients more easily, without having pain and agitation. In fact, in the present study, neuromonitorization was provided with MEP in all patients and wake-up test was performed at least once during the operation and agitation wasn't observed in any patient during the test.

In the current study total intravenous anesthesia was used in anesthesia maintenance as it has the minimum effect on MEP measurements. It was thought that being a short-acting drug, remifentanil would not influence analgesic effects of postoperative morphine. Multimodal analgesia is a rational approach in treatment of postoperative pain. Better results have been achieved with multimodal analgesia when compared with preemptive analgesia. As synergistic effects of different techniques are used and lower doses are

required and lesser side effects are observed in multimodal analgesia.[14]

In another study in Australia, it was reported that multimodal analgesia with paracetamol, parenteral opioids, NSAIDs, epidural local anesthetic or opioid infusions, intrathecal opioids, intravenous ketamin infusion at subanesthetic doses are preferred in pediatric scoliosis surgery at the present time.[15]

Elie et al. reported that NSAIDs have opioid-sparing effects following major surgery, decrease the intensity of pain and decrease the morphine-related side effects.[16] However the nonsteroidal drug that produces the maximum opioid sparing effect is not clear yet. Hiller et al. reported that acetaminophen has improved analgesia in patients undergoing idiopathic scoliosis or spondylolisthesis surgery however hasn't decreased the opioid requirements.[17] Thus in the current study, a single dose of NSAID (Diclomec) was administered at a low dose (75 mg) owing to the thought that it might increase bleeding during the postoperative period and disturb bone healing.[18]

Postoperative pain is acute pain syndrome which induces release of mediators such as prostaglandin, histamine, serotonine from the site of injury and thus cause activation of "Postinjury stress response". It has been demonstrated that peripheral pain transduction could be modulated by inhibition of transmission of noxious impulses that arise from the site of injury through the wound infiltration with local anesthetics.[19]

Liu et al. have reported that wound infiltration has many benefits, improves analgesia, decreases systemic opioid dose and side effects, increases patient satisfaction and decreases the duration of hospital stay.[19]

In the study by Reynolds et al., related to the wound infiltration for postoperative pain management following spinal fusion surgery, both catheters of On -Q Pain buster system were subcutaneously placed by the orthopedic surgeon just before the wound closure and bupivacaine and saline solution were infused in addition to the postoperative analgesia protocol (combination of intraoperative intrathecal morphine, postoperative PCA, oral opioid+acetaminophen). As a result, approximately 0.5 mg/kg less opioid was required within the first 24 hours.[20] In the present study the authors performed wound infiltration with 50% diluted levobupivacaine solution before wound closure. The recommended local anesthetic in wound infiltration is ropivacaine due to its intrinsic vasocontrictive effect and its lesser potential for cardiotoxicity.[19] However as there is no commercially available ropivacaine in Turkey, levobupivacaine was used in the present study.

All of the cases included to the current study were relatively simple scoliosis cases including 6-7 segments. In cases including several segments, there might be problem in insertion of epidural catheter and high volumes of local anesthetic would be required and this might cause systemic toxicity. In the current study the total volume of levobupivacaine 0.25% didn't exceed 20 mL in cases including maximum 6-7 segments. Systemic local anesthetic toxicity wasn't observed in the current study. This might be due to using local anesthetic at a dose lower than toxic dose, less absorption of the drug by subcutaneous route and fractional administration of the total dose with an interval. Postoperative VAS scores were low, the highest pain scores were measured at 12th and 24th hours. However as the highest VAS value didn't exceed 4, additional analgesic wasn't required. One of the findings of providing sufficient analgesia was the sleep quality being good. No morphine-related side effects were observed as there was no need for postoperative morphine use and the patient satisfaction was evaluated as good. All patients were orally fed at the end of 24 hours. This could be due to effective pain management in addition to not using morphine.

In the current study, it could be thought that epidural catheter placement in patients with scoliosis might be difficult. However the vertebra of the adolescent patients is elastic and could be easily made straight by positioning. Epidural catheter was easily inserted in all patients in the present study. However epidural catheter placement would not have been possible in

advanced age group. In the study of Wenk et al., the physibility and effectiveness of preoperative epidural catheter placement in anterior scoliosis surgery was investigated. For this purpose, thoracic epidural catheter (TEC) was inserted and the success rate of TEC placement was found as 96.6%, However the catheter was placed intrapleurally in one patient and Horner syndrome was observed in another. In the prementioned study the VAS scores were lower than 5 similar to the current study and only 7% of the patients required rescue analgesia.[21]

One of the limitations of the current study is that the patients were monitorized for 24 hours. The reason for this was that the patients and their families became unhappy for being in PACU and desired to be transferred to ward in a short time. So the authors of the current study restricted the duration of postoperative follow-up with 24 hours owing to the fact that it would be difficult to follow-up the patients in ward. We also thought that long duration of PACU stay would not be convenient in terms of infection risk. At the end of 24 hours' follow up all patients were safely transferred to the ward.

In conclusion; preemptive segmental epidural levobupivacaine and morphine administration combined with wound infiltration is an effective and reliable analgesic method in patients undergoing posterior instrumentation and fusion surgery. However we think that further studies related to new drug protocols that would have minimal effect or no effect on MEP signals just as the current study and with longer duration of follow-up are needed.

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