Research Article

Ketamine versus Dexamethasone as an Adjuvant to Local Anesthetics in Combined Sciatic-Femoral Nerve Block for Below Knee Surgeries

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Abstract
Background: Ketamine is the drug that is used in human and veterinary medicine, especially S-ketamine that is undergoing renewed interest as an additive to local anesthetics. At the same time, Steroids produce analgesia by blocking transmission in nociceptive c-fibres and suppressing ectopic neuronal discharge. **Patients and methods:** Three groups, Control group (A) patients received combined sciatic-femoral nerve block with injection of bupivacaine and lidocaine **Ketamine group (B)** patients received combined sciatic-femoral nerve block with injection of bupivicaine , lidocaine and ketamine. **Dexamethasone group (C)** patients received combined sciatic-femoral nerve block with injection of bupivicaine, lidocaine and dexamethason. **Results:** Onset time of sensory and motor blocks was significantly decreased in ketamine group and dexamethasone group in comparison with the control group. The visual analogue scale was significantly lower in patients who received ketamine and dexamethasone versus patients who received local anesthetics only. The duration of analgesia and resolution of motor block were significantly prolonged in ketamine and dexamethasone groups as compared to control group. Postoperative analgesic consumption was reduced significantly in ketamine and dexamethasone groups as compared with control group. **Conclusion**, Addition of ketamine and dexamethasone to a mixture of lidocaine results in a significant decrease in onset time of sensory & motor blocks, prolonged duration of postoperative analgesia and lower analgesic consumption as compared to local anesthetics alone in patients undergoing combined sciatic-femoral nerve block .
Key words: Ketamine, Dexamethasone, Visual analogue scale, Lidocain.

Introduction
Local anesthetics administered as regional nerve blocks are utilized in providing postoperative pain relief.[١] Certain drugs may be used as adjuvant to local anesthetics.[٢] Bupivacaine binds to the intracellular portion of sodium channels and blocks sodium influx into nerve cells, also blocks specific potassium channels.[٣]

Lidocaine alters signal conduction in neurons. NMDA receptor antagonists as ketamine have been used to decrease postoperative pain and analgesic requirements in adult patients undergoing surgical procedures.[٤,٥] Steroids have anti-inflammatory and analgesic effects. They relieve pain by reducing inflammation, blocking transmission in nociceptive c-fibers and suppressing the ectopic neuronal discharge.[٦]

Patients and Methods
After approval of the local ethics committee of El-Minia university hospital, forty patients of either sex, aged between ١٨-٦٠ years old, ASA I & II, scheduled to undergo an elective below knee surgery, under combined sciatic-femoral nerve block guided by nerve stimulator were enrolled in this prospective randomized double blind study. We excluded Patient who refused the technique of the block, uncooperative patients, damaged or diseased sciatic or femoral nerve. Patients with coagulopathy, neuromuscular diseases or peripheral neuropathy, local infection at the site of

injection or known allergy to any of the studied drugs.

***Preoperative assessment*:** Medical history, Physical examination (chest, heart, abdomen and other systems) were carried out. Routine investigations were done.

***Equipments and drugs used in the study*:** nerve stimulator, ٢٠-gauge short bevel, insulated stimulating needle,١٠-mL syringes for injection, Sterile, ١½ ٢٥-gauge needle for skin infiltration, lidocaine ٢٪ vial ٥٠ml: ٢٠mg in each ١ml (sigma-Tec Pharmaceutical Industries Co.). bupivacaine ٠.٥٪ vial ٢٠ml: (Actavis Group PTC). Ketamine: [Ketamine, ٥٠ mg/ml injection, Sigma EG, Egypt]. dexamethazone: [Dexa-methasone SOD. ٨mg/٢ml injection, Epico, Egyptian Pharmaciutical International Company Egypt].

Preparation of the studied medications: This was a prospective randomized double blind study (neither the investigator nor the patients know the nature of the drugs given). The unknown solutions were prepared by the supervisor in bottles labeled as A , B or C for injection each bottle contain ٤٠ ml solution. The key of this study was opened at the conclusion of the study and the groups were as follow: **Control group (A)** included ٢٠ patients who received combined sciatic-femoral nerve block with injection of ٣٠ ml bupivacaine ٠.٥٪, ٨ ml lidocaine ٢٪ and ٢ ml saline **Ketamine group (B)** included ٢٠ patients who received combined sciatic-femoral nerve block with injection of ٣٠ ml bupivicaine ٠.٥٪, ٨ ml lidocaine ٢٪ and ٢ ml of ٥٠ mg ketamine made in saline. **Dexamethasone group (C)** included ٢٠ patients who received combined sciatic-femoral nerve block with injection of ٣٠ ml bupivicaine ٠.٥٪, ٨ ml lidocaine ٢٪ and ٢ ml of ٨mg dexamethasone.

Technique of combined sciatic-femoral block: anterior approach technique.

Parameters assessed: Hemodynamic parameters were evaluated preoperatively and intraoperatively every ٥ minutes after local anesthetic injection for a total of ١٢٠ min by an independent blinded observer.

Sciatic nerve block assessment:

١- Onset of sensory block: the time interval between the end of injection of local anesthetic and complete sensory block in the distributions of the common peroneal and tibial nerves. The extent of sensory block of each nerve was classified as follows: ٠ = normal sensation (no block), ١= blunted sensation (analgesia) and ٢ = absence of sensation (anesthesia). Sensory testing using the pin prick test with an١٨gauge hypodermic needle in the sciatic nerve distributions.[٢]

٢-Onset of motor block: the time interval between end of local anesthetic injection and complete motor block, assessed for voluntary motor responses by asking the patient to plantar flex or dorsiflexion the foot, classified as follows: ٠ = normal movement, ١ = decreased movement and ٢ = no movement.[٢]

٣-Duration of sensory block: the interval time between the onset of complete sensory block and time of reappearance of parathesia in the blocked limb.

٤- Duration of motor block: the interval time between the onset of complete motor block and complete recovery of motor function in the blocked limb.

Femoral nerve block assessment:

١- Onset of sensory block: the time between the end of injection of local anesthetic and complete sensory block in the distributions of the common peroneal and tibial nerves.

٢- Onset of motor block: was assessed for voluntary motor responses by asking the patient to extend the knee.

٣- Visual analogue pain scale (VAS): measured every ١٥ minutes during surgery, ٠ point (no pain) ١٠ point (maximum pain imaginable). If VAS was more than ٣, supplemental IV fentanyl was given[٧], if this did not provide adequate conditions, general anesthesia was induced and the case considered failed and excluded from our results.

Postoperative pain assessment in ١st ٢٤ hrs: by (VAS) at ٢, ٤, ٦, ٨, ١٢, and ٢٤hrs postoperative.

Statistical Analysis

Data were represented as means ± standard deviation of the mean (SDM). Statistical analysis was performed using Graph pad Prism ٥ software and significant difference between groups was done by one-way ANOVA followed by Tukey-Kramar post hoc test for multiple comparisons with a value of $P \leq ٠.٠٥$ considered statistically significant.

Results

Patient's characteristics: There were no statistical significant differences ($P > ٠.٠٥$) between the three groups as regards age, weight, sex ratio, ASA classification, duration of surgery, medical problems and site of surgery. Table (١).

Onset time of sensory and motor block: The onset time of sensory block was significantly shorter in ketamine group (٢٠.٦٥ ± ٤.٦٢ min.) and dexamethasone group (٢١.٦٥± ٤.٤٣ min) than in the control group (٣١.٨± ٦.٢٢ min.). In addition, onset time of motor block was significantly shorter in ketamine group (١٧.١٥±٤.٢٢ min.) and dexamethasone group (١٨.٥٥± ٤.٩٣ min.) than in the control group (٢٧.٣ ±٥.٤٤ min.) ($P < ٠.٠٠١$). Figure(١).

Duration of sensory and motor block: As demonstrated in Table (١), duration of sensory block was significantly prolonged in ketamine group (١٥.٩ ± ٣.٥٢ hr.) and in dexamethasone group (١٦.١٧ ± ٢.٢٦ hr.) in comparison to control group (٩.٦٧ ± ٢.٦٧ hr.) ($P < ٠.٠٠١$).

Also duration of motor block was significantly prolonged in kitamine group (١٨.١ ± ٣.٤٦ hr.) and in dexamethasone group (١٨.٢ ± ٢.٩٤ hr.) in comparison to control group (١٠.٧٧± ٢.٧٩hr.) ($P < ٠.٠٠١$). Figure (٢).

Visual Analogue Pain Scale (VAPS)

Within group comparison for the difference of VAPS was done by Wilcoxon's signed-rank test and there was a significant difference at the control group (A) between the base line and ٢ hr, ٤ hr, ٨hr, ١٠hr and ١٦hr post-operatively. And also there was a significant difference in both the ketamine group and B dexamethasone group (C)) between the base line and ٤hr, ٦hr, ٨hr, ١٠hr, and ١٢hr post-operatively.While comparison between each two groups at specific intervals was made by Mann Whiteny U-test and there was statistically significant reduction of VAPS in ketamine group than control group, also there was statistically significant reduction of VAPS in dexamethasone group than control group. While there was no significant difference between ketamine group and dexamethasone group as shown in figure (٣).

Total analgesic consumption: Postoperative analgesic regimen consisted of I.V. ketolac (٣٠mg amp) whenever VAPS became > ٤. There was a statistically significant difference between the ketamine group and dexamethasone group in comparison with the control group ($P < ٠.٠٠١$) regarding analgesic consumption which was lower in ketamine group (٦١.٦٦ ± ٢٤.٠٧ mg) and in dexamethasone group (٥٤ ± ٢٠.٨٧ mg) than in control group (١٢٠ ± ٢١.٧٦ mg).

Regarding heart rate, mean arterial blood pressure and oxygen saturation, they were stable with minimal variation between the ٣ groups which were not statistically significant.

Tables:

Table (١a): Patient's characteristics of the study groups

Variables	Control Group A	Ketamine Group B	Dexamethazone Group C
	N = ٢٠	N = ٢٠	N = ٢٠
Age: (years) (M ± SD)	٣٧.٢ ± ١٤.٥٩	٣٥.٨٥ ± ٨.٨٦	٤٠.٨٥ ± ١٠.٦٨
Weight : (Kg) (M ± SD)	٧٢.٧ ± ١١.٨٥	٧٥.٤ ± ٩.٣٨	٧٨.٦٥ ± ١٥.٢٢
Sex: Male. Female.	١٠ (٥٠٪) ١٠ (٥٠٪)	١٥ (٧٥٪) ٥ (٢٥٪)	١٤ (٧٠٪) ٦ (٣٠٪)

Values are expressed as means ± SD or numbers and percentages. (N=number).

Table (١b): Patient's characteristics of the study groups

Variables	Control Group A	Ketamine Group B	Dexamethazone Group C
	N = ٢٠	N = ٢٠	N = ٢٠
ASA: Class I; Class II.	١٧ (٨٥٪) ٣ (١٥٪)	١٨ (٩٠٪) ٢ (١٠٪)	١٣ (٦٥٪) ٧ (٣٥٪)
Duration of surgery: (min) (M ± SD)	٦٠ ± ٢١.٠٨	٦١.٧٥ ± ٢٦.٢٧	٥١.٢٥ ± ٢٢.٧٦
Medical problems: n (%)			
No.	١٧ (٨٥٪)	١٨ (٩٠٪)	١٣ (٦٥٪)
HTN.	١ (٥٪)	١ (٥٪)	١ (٥٪)
Diabetes.	٢ (١٠٪)	١ (٥٪)	٤ (٢٠٪)
HTN & Diabetes.	٠ (٠٪)	٠ (٠٪)	٢ (١٠٪)
surgery site: n (%)			
Knee.	١١ (٥٥٪)	١٠ (٥٠٪)	٧ (٣٥٪)
Tibia.	٤ (٢٠٪)	٤ (٢٠٪)	٢ (١٠٪)
Ankle.	٣ (١٥٪)	١ (٥٪)	٣ (١٥٪)
Foot.	٢ (١٠٪)	٥ (٢٥٪)	٨ (٤٠٪)

Values are expressed as means ± SD or numbers and percentages. (N=number).

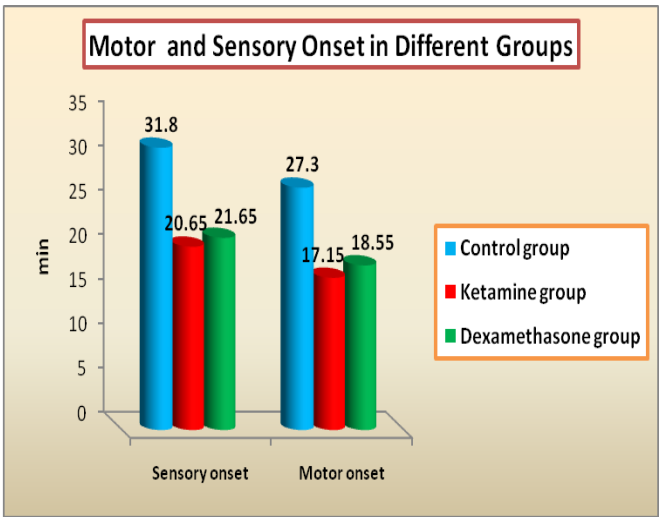

Figure (١): Motor and sensory onset in different groups

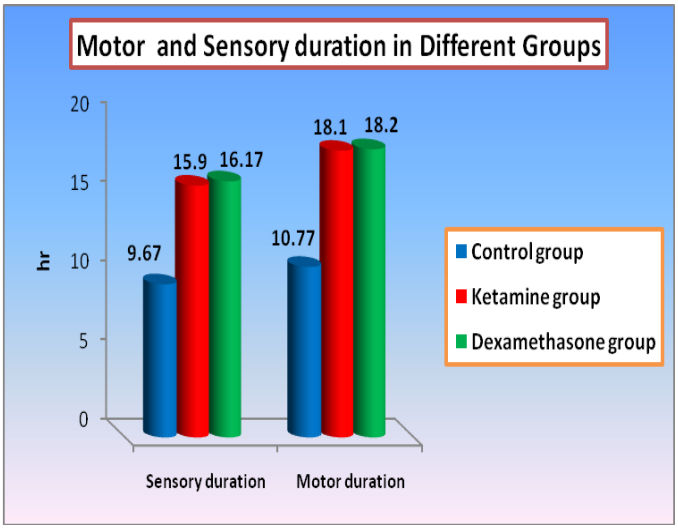

Figure (٢): Motor and sensory duration in different groups

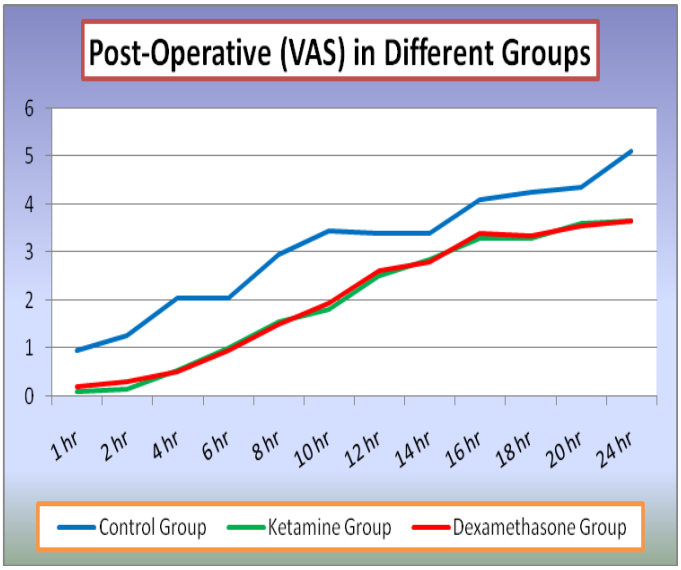

Figure (٣): Post-operative (VAS) in different groups

Discussion

As the lower limb surgery is often associated with severe and long-lasting postoperative pain requiring large amounts of parenteral opioids. The sciatic nerve block may be used alone or in combination with other peripheral nerve blocks for orthopedic procedures involving the lower limb. [٨] Local anesthetics alone provide analgesia for not more than ٤-٨ hours. Increasing the duration of local anesthetic action is often desirable because it prolongs surgical anesthesia and analgesia. Different additives have been used to prolong regional blockade. Vasoconstrictors can be used to vasoconstrict vessels, thereby reducing vascular absorption of the local anesthetic. Additives like opioids, clonidine etc. were added to local anesthetics, but the results are either inconclusive or associated with side effects.[٩] The aim of our study was to compare the effect of addition of ketmaine (٥٠mg) versus dexamethasone (٨ mg) to lidocaine ٢٪ and bupivacaine ٠.٥٪ mixture on onset time of sensory & motor blocks and postoperative analgesia in combiened sciatic-femoral nerve block in below knee surgries.

In the present study, the addition of ketamine to local anesthetics mixture in combined sciatic-femoral nerve block results in a significant reduction in onset time of sensory & motor blocks, prolonged duration of postoperative analgesia, lower analgesic consumption with a high degree of patient satisfaction. Ketamine has various central effects mediated primarily by the NMDA receptor. Ketamine has been shown to prolong postoperative analgesia when given as an adjuvant to epidural anesthesia but its effect when added to local anesthetics for nerve or plexus block remains unclear. The mechanism of the peripheral effect of ketamine leading to enhancement of the local anesthetic and analgesic effects of bupivacaine is not clear. It can be related to the blockade of NMDA receptors.[١٠] Sansone et al., [١١] found that selective block of the femoral and sciatic nerves were performed on ٦٠١ patients undergoing knee arthroscopy. The results were good in ٨٧٪, adequate in ١٢٪, and poor in ١٪.

This study disagrees with our results as we found that (٥٣.٣٣٪) perfect, (٣٥٪) were acceptable and (١١.٦٪) were poor and this might be due to the difference in the number of patients included in both studies and the difference in the groups as in our study patients were devided into three groups while in their study all patients were included in a single group also there was difference in the drugs used in the local anesthetics injected. Furthermore, the effect of ketamine on nerve conduction was later confirmed in *in-vitro* experiments by Weber et al., [١٢] who also reported that, in volunteers, the subcutaneous infiltration of ٠.٥٪ ketamine caused a loss of thermal and pain sensations for ٨–١٠ min. On the other hand, the study done by Lee et al., [١٣] evaluating the effect of adding ٣٠mg ketamine to ٠.٥٪ ropivacaine in the brachial plexus block had no effect on the onset and duration of block and cause a relatively high incidence of adverse effects. The results Lee et al., [١٣] are contradictory to the presented results. This is related to; the difference in ketamine dose used in the block as we used a higher dose, differences in volume of local anesthetics mixture injected in the procedure as we used a higher volume, the difference in nature of local anesthetics administered in the block and differences according to the technique used to perform the block and study protocol. Data of the present study showed that the addition of dexamethasone to local anesthetics mixture in combined sciatic-femoral nerve block results in a significant reduction in onset time of sensory & motor blocks, prolonged duration of postoperative analgesia, lower analgesic consumption with a high degree of patient satisfaction. Movafegh et al., [١٤] evaluating the effect of adding dexamethsone (٨mg) to local anesthetics in axillary brachial plexus block reported that the addition of dexamethasone to lidocaine prolonged the duration of sensory and motor blockade without changing the onset time.

In the present study, heart rate, mean arterial blood p ressure and oxygen saturation, showed no significance differences compared to the control group. These findings are supported by Movafegh et

al.,[١٤]; Lee et al.,[١٣] and Islam et al.,[١٥] Data of the present study showed a significance shorting in the mean onset time of sensory and motor blocks in ketamine and dexamethasone groups as compared with the control group. However, there were no statistically differences between the ketamine and dexamethasone groups. In agreement with these results Islam et al., [١٥] reported that motor onset in group-A patients received mixture of lignocaine ٢٪ and bupivacaine ٠.٥٪ was similar to results of patients in control group in our study and also similar to our results in dexamethasone group. However, Movafegh et al., [١٤] found that there is no effect on addition of dexamethasone to local anesthetics on the onset of sensory and motor block. In the present study, the duration of analgesia was significantly longer in patients who received ketamine and dexamethasone compared to patients who received local anesthetics alone. Also, the time to resolution of motor block was significantly prolonged in ketamine and dexamethasone groups when compared to control group. There was a significant reduction in Postoperative analgesic consumption in ketamine and dexamethasone groups as compared to control group.

The current study has confirmed the findings of a previous study performed by Tverskoy et al.,[١٦] who found that post-operative pain score in ketamine group were significantly lower than the control group in case of ketamine infiltration. In our study, there was prolongation in the duration of postoperative analgesia and resolution of motor block in dexamethasone group which is similar to findings reported by Movafegh et al.,[١٤] and Islam et al.,[١٥] . In the present study, ٥٤ patients out of ٦٠ were judged as clinically successful (٩٠٪). The high success rate obtained in our study is supported by Borgeat et al.,[١٧]. The percentage of patients who were satisfied from combined sciatic-femoral nerve block was (٨٠٪) excellent, (١٠٪) good and (١٠٪) fair in ketamine group and was (٧٠٪) excellent, (١٥٪) good and (١٥٪) fair in dexamethasone group while was (١٠٪) excellent, (٥٥٪) good and (٣٥٪) fair according to satisfaction with high statistical signify-cance. All previous literature Tverskoy et al.,[١٦] Lee et al.,[١٣] and Islam et al.,[١٥] didn't comment on patient satisfaction. The results of this study revealed that no complications were recorded in control and dexame-thasone groups, however, in ketamine group seven patients had hallucinations. The recorded side effects were reversible and disappeared spontaneously in few hours. None of the patients had technical complications during the procedure in the three groups**.**

Conclusion

Addition of ketamine in a dose of (٥٠ mg) and dexamethasone in a dose of (٨ mg) to a mixture of lidocaine ٢٪ and bupivacaine ٠.٥٪ results in a significant decrease in onset time of sensory & motor blocks, prolonged duration of postoperative analgesia and lower analgesic consumption as compared to local anesthetics alone in patients undergoing combined sciatic-femoral nerve block .

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