Research Article

Evaluation of Neuraxial Magnesium Sulphate as Adjuvant to Bupivacaine ٠.٥٪ for Subarchnoid Block in Orthopedic Surgery.

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Abstract
Aim of work: This randomized, double blinded clinical trial was to compare between two intarhecal adjuvants, magnesium sulphate in two doses ٥٠,and ٧٥ mg and fentanyl when added to hyperbaric bupivacaine ٠.٥٪ in lower limb surgeries performed under spinal anesthesia. **Patients and methods:** After ethical committee approval, and obtaining informed written consent, ١٣٢ ASA physical status I or II scheduled for lower limb surgery under spinal anesthesia were randomized into four equal groups each of which was thirty three patients: group A received ٢ml of hyperbaric bupivacaine ٠.٥٪ plus ١ml of normal saline , group B received ٢ml of hyperbaric bupivacaine ٠,٥٪ plus ٠.٥ ml(٥٠mg) of magnesium sulphate ١٠٪ plus ٠.٥ ml normal saline, group C received ٢ ml of hyperbaric bupivacaine ٠.٥٪ plus ٠.٧٥(٧٥mg) magensium sulphate ١٠ % plus ٠.٢٥ ml normal saline, group D received ٢ml of hyperbaric bupivacaine ٠.٥٪ plus٠.٥ ml fentanyl (٢٥µg) plus ٠.٥ml normal saline. Onset, duration of sensory and motor block, ١st analgesic request, hemodynamic prameters were recorded. **Results:** Intrathecal magnesium sulphate delayed onset of sensory and motor block even more than the control group while fentanyl shortened the onset time. Magnesium, and fentanyl prolonged the duration of spinal anesthesia and this prolongation increased with increased the dose of magnesium. Incidence of side effects such as pruritus, bradycardia, and hypotension was less with magnesium than other two groups. **Conclusion:** Intrathecal magnesium when used as adjuvant to ٢ ml of hyperbaric bupivacaine ٠.٥٪ in lower limb surgeries delayed onset of both sensory and motor blockand prolonged the duration of spinal anesthesia more than fentanyl and control group with less incidence of side effects.

Key words: magensium sulphate, spinal anesthesia, fentanyl,

Introduction
Subarachnoid block is the first choice of anesthesia in orthopedic surgery in the lower limb because of its multiple advantages such as its fast action, high safety profile, less costs, and less incidence of thromboembolism but it has a weak point which is its short duration and lack of postoperative analgesia[١]. A wide variety of drugs were added to the local anesthetic in subarachnoid block such as clonidine, neostgmine, ketamine, and epinepherine to overcome this disadvantage but all of them exhibited many side effects[٢].

Opioids such as fentanyl were added to the intrathecal local anesthetic to prolong and potentiate its action but they were associated with significant side effects like nausea, vomiting, itching, urine retention, and respiratory depression which limit its use as adjuvant to local anesthetic in subarachnoid block[٣].

Magensium is an important body cation and it is essential for many physiological processes and it is defined as physiological calcium antagonist[٤]. Magensium is a non-competitive antagonist of N-methyl D-aspartate receptors present in the central nervous system which responsible of central sensitization(increased excitability of spinal neurons) and wind up which in turn leads to persistence of postoperative pain[٥] .

Many researchers examined the efficacy of peri-operative intravenous magnesium

sulphate for prevention of postoperative pain and they found conflicting results where many studies showed that subarachnoid administration of magnesium could prolng spinal analgesia[٦] while other studies[٧] reported no direct benefit from subarachnoid administration of magnesium in pain or analgesic requirements and they explained this conflict by the limited passage of magnesium through the blood brain barrier [٨]. It was suggested that direct administration of magnesium in the subarachnoid space with direct contact with dorsal horn N-methyl D- Aspartate receptors would increase its action and this was examined in many researches which found that intrathecal administration of magnesium would prolong the duration of subarachnoid anesthesia[٩]. The hypothesis of this study was that addition of magnesium to local anesthetic in the subarachnoid block would prolong the duration of spinal anesthesia in orthopedic surgery in lower limb without significant side effects. This prospective randomized double blind study was designed to compare between the effect of two intrathecal magnesium doses (٥٠ mg and ٧٥mg) and fentanyl ٢٥µg when added to intrathecal bupivacaine ٠.٥٪ on the onset and duration of sensory and motor block (primary outcome), highest sensory level, time to two segments regression, duration of spinal anesthesia, hemodynamic parameters, and side effects (secondary outcomes).

Methods

This prospective, randomized, double blinded study was performed in El –Minia university hospital in the period from August ٢٠١٣ to January ٢٠١٤. After obtaining approval of the ethics committee of the faculty of medicine and informed written consents from the patients. One hundred thirty two patients ASA I or II aged from ٢٠ to ٤٠ years scheduled for orthopedic surgery in the lower limb under spinal anesthesia. Patients with coagulopathy, infection in the site of the block, allergy to LA used, or sensitivity to prescribed analgesics, and those who refused to participate in the study were excluded.

Patients were allocated randomly into four equal groups each of which is thirty three patients using computer generated randomized numbers, the allocation ratio was ١:١ and the identification cards was put in a sealed envelops to hide the allocation.

Group A: they received ٢ ml of hyperbaric bupivacaine ٠.٥٪ plus ١ ml of preservative free normal saline.
Group B: they received ٢ ml of hyperbaric bupivacaine ٠.٥٪ plus ٠.٥ ml magnesium sulphate ١٠ % (٥٠ mg) plus ٠.٥ ml of preservative free normal saline.
Group C: they received ٢ ml of ml of hyperbaric bupivacaine ٠.٥٪ plus ٠.٧٥ ml magnesium sulphate ١٠ % (٧٥ mg) plus ٠.٢٥ ml of preservative free normal saline.
Group D: they received ٢ ml of ml of hyperbaric bupivacaine ٠.٥٪ plus ٠.٥ ml fentanyl (٢٥ µg) plus ٠.٥ ml of preservative free normal saline.

Local anesthetic combination was prepared by anesthesiologist not included in the study in syringes of equal volume for the purpose of blindness, each of which was three ml in each. All patients were fasted for ٦ h pre-operatively, and they received ١٠ mg oral diazepam and ١٥٠ mg oral ranitidine on the morning of the surgery. At the operation room١٨ gauge cannula was inserted in the hand opposite to the fracture side, and patients received fluid preload with ١٠ ml/kg of lactated Ringer's solution. Patients were attached to a multi-channel monitor (Hewlett Packward, Viridia ٢٤ Germany) to record base line Electrocardiogram (ECG), heart rate (beats /min), systolic, diastolic blood pressure, and oxygen saturation ($SpO_٢$).

Anesthetic technique: with the patients in sitting position and after sterilization of the back of patients with Bovidone-iodine ١٠%, subarachnoid block was done using ٢٥-gauge Quincke spinal needle (Spinocan, BBraun medical, Melsungen, Germany) at L٣-L٤ interspace through midline approach. After free flow of clear cerebrospinal fluid (CSF), the local anesthetic mixture was injected by the anesthesiologist blinded with type of the solution. Time of complete intrathecal injection was considered as ٠

time. Patients lied in supine position with nasal cannula which delivered oxygen at ٣ L/minute.

Parameters were recorded:

- Sensory block: It was examined by pin-prick at the midclavicular line every ٢ minutes after intrathecal injection till ٢٠ minutes and then every ١٥ minutes. Time of onset of sensory block (time from intrathecal injection to loss of pinprick sensation at T ١٠ dermatome), height of sensory block (highest dermatome with lost sensation in two sequential times), time to highest sensory block and duration of sensory block (time to two segment regression).
- Motor block was assessed by Bromage scale (I= free movement of legs and feet, II = just capable of knees flexion with free movement of feet, III=incapable of knees flexion, capable of feet's flexion, IV= incapable of feet or knees flexion)[١٠] every ٢ minutes until complete motor block (Bromage scale IV) and then every ١٥ minutes until complete motor recovery (Bromage scale I). Time to complete motor block and time to complete motor recovery were recorded.
- Hemodynamic parameters such as heart rate (beats/min), and non invasive systolic, diastolic, and mean blood pressure (mmHg) and oxygen saturation were recorded just before intrathecal injection (base line), ١, ٥, ١٠, ١٥ minute after intrathecal injection and then every ١٥ minutes till end of surgery. Hypotension was defined as drop of systolic blood pressure more than ٢٠٪ of the base line value or below ٩٠ mmHg and it was treated by bolus intravenous ephedrine ١٥ mg and repeated if necessary. Bradycardia was defined when heart rate decreased below ٥٠ beats/minute and it was treated by bolus intravenous atropine ٠.٥ mg and repeated if necessary. Respiratory depression was recorded when oxygen saturation was below ٩٠ and it was treated by increase oxygen flow or mask ventilation as required.
- Incidence of hypotension, bradycardia, respiratory depression, excessive sedation, pruritus, nausea and vomiting was recorded. At the end of the surgery, patients were transported to the post anesthesia care unit PACU till complete motor recovery, stable vital signs, and absence of nausea and vomiting then transported to the ward. Time for first analgesic request (time from intrathecal injection to ١st analgesic request) was recorded.

Statistical analysis

Using PASS (Power Analysis and Sample Size System) software (NCSS, East Kaysville, Utah, USA)., it was found that the least number of patients required in each group to detect ٢٥ minutes difference in the duration of motor power of spinal anesthesia with ٩٥٪ power and ٠.٠٥٪ significance level was ٣٠ patients and with ١٠٪ dropout ratio, the number increased to ٣٣ patients in each group.

Data were analyzed with Statistical Program SPSS version ٢١ (SPSS Inc., Chicago, IL, USA). Quantitative data were expressed as mean± SD, while qualitative data were expressed as frequency. Data were tested for normal distribution by Kolmogorov- Smirnov test. Analysis of variance ANOVA was used to compare between the means of the groups followed by post-hoc test. Independent -T-test was used for comparison of numerical data within the same group. Students T- test was used to analyze normally distributed continuous data between two groups. Categorical data were analyzed by Fisher's exact test to compare between proportions. All tests are two-tailed and *P* value of <٠.٠٥ was considered significant.

Results

One hundred thirty two patients were eligible for the study. They were randomized into four equal groups each of them was thirty three patients, all of them continued the study to be analyzed as shown in the flow chart of the study Fig(١). There was no significant difference between the four groups as regards the demographic data and the duration of the surgery table (١).

As regard the mean blood pressure, there was no significant difference in the baseline values between the four groups. There was a significant decrease in the mean blood

pressure values when compared to the base line values in the four groups started from the five minutes readings and continued till ٣٠ minutes readings, without any significant difference between the four groups table (٢).

As regards the heart rate, there was no significant difference in the baseline values between the four groups. There was a significant decrease in the heart rate values when compared to the base line values in the four groups started from the ٥ minutes values and continued to ٣٠ minutes values in control group and magnesium groups while it continued to the end of the study in fentanyl group table (٣).

As regards the spinal anesthesia characters, there was significant delay in the onset time of sensory and motor block in magnesium groups (B and C) more than the control (A) and fentanyl group (D) which was the fastest onset. There was significant prolongation of the duration of sensory and motor block in the magnesium groups (B and C) and fentanyl group (D) when compared to control group(A) but no significance between magnesium and fentanyl. As regards time for the ١st analgesic request was significantly prolonged in magnesium (B, C) and fentanyl (D) groups when compared to (A) control group, and significant prolongation of group (C) magnesium ٧٥ mg when compared to group B, and D but there was no significance between magnesium ٥٠ mg(B) and fentanyl group (D) table (٤).

As regards the incidence of side effects, all groups did not show excessive sedation or respiratory depression. Fentanyl group (D) showed significant increased incidence of pruritus and bradycardia in comparison to other groups.

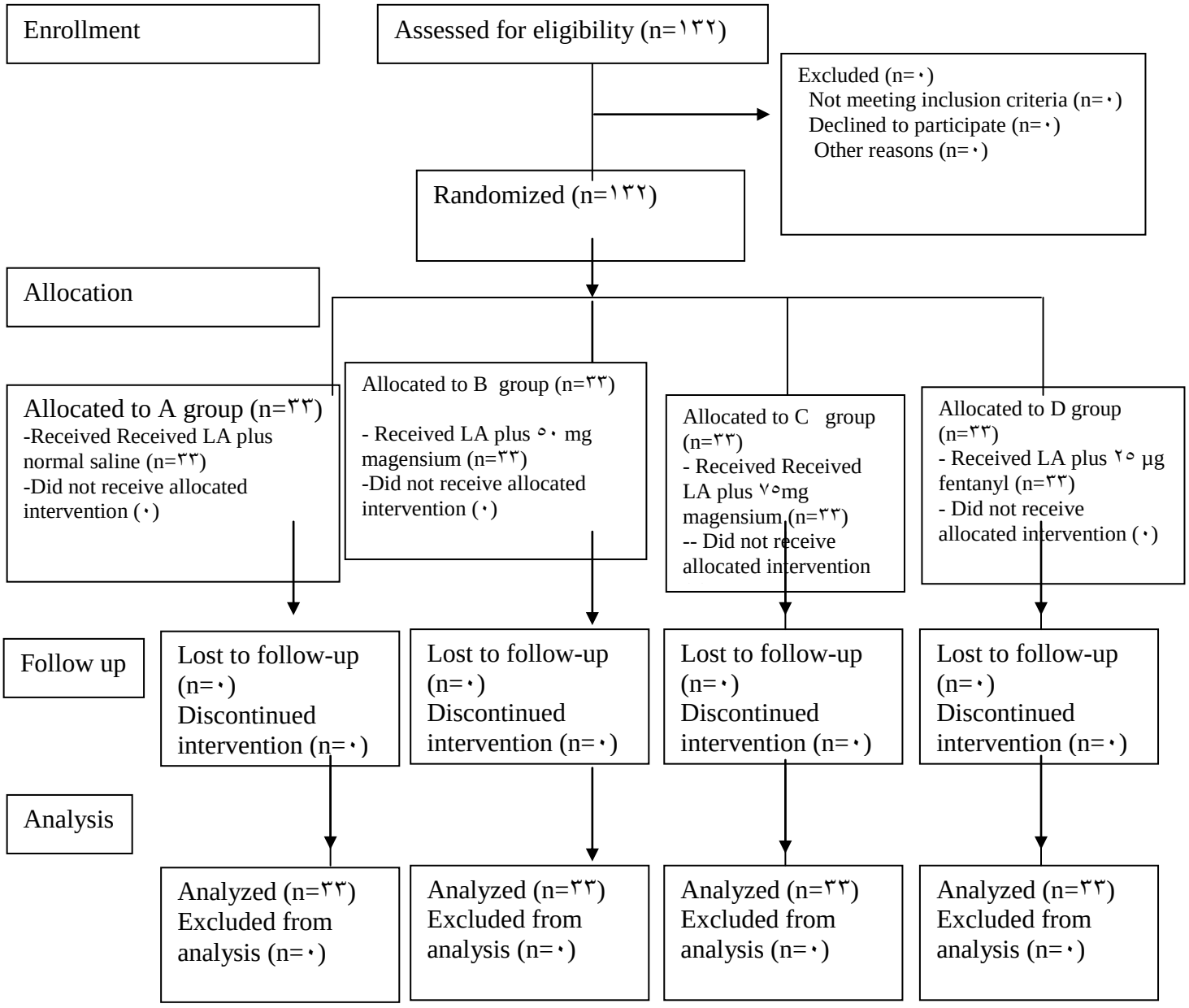

Figure (١) Flow chart in the study.

Table (١): Characteristics of the patients and duration of surgery

	Group A (n=٣٣)	Group D (n=٣٣)	Group C (n=٣٣)	Group D (n=٣٣)	*P* value
Age (years)	٣٠±٨	٣١.٧±٧.٤	٢٩.٨±٥.٩	٢٨.٧±٦.٤	٠.٣٧٥
Weight(kg)	٧٧.٩±٧.٤	٧٨.٥±٦.٩	٧٧.٦ ±٧	٧٨.١±٦.٥	٠.٩٦٢
Height(cm)	١٧١.٥±٨.١	١٧٣.٦±٧.٦	١٧٠.٤±٦.٤	١٧٢.٢±٦.٠	٠.٣١٩
ASA I/II	٢٥/٨	٢٤/٩	٢٤/٩	٢٢/١١	٠.٨٧٠
Sex♂/♀	٢٠/١٣	١٨/١٥	٢٢/١١	٢٣/١٠	٠.٥٩٠
Duration of surgery (min)	٩٠±١٤	٩٥±١٣	٩٢±١١	٩٤±١١	٠.٣٦٥

Data were expressed as mean ± SD or number. *P* value between the four groups. No significant difference. *P* value > ٠.٠٥.

Table(٢): Comparison of mean arterial blood pressure (mmHg) between and within the four groups.

	Group A (n=٣٣)	Group B (n=٣٣)	Group C (n=٣٣)	Group D (n=٣٣)	*P* value
Base line	٩٢.٧±٥.٨	٩٣.٤±٤.٨	٩٢.١±٥.٧	٩٤.٣±٥.١	٠.٣٨٢
١ min AS	٨٥.٤±٣.١	٨٦.١±٣.٣	٨٥.٧±٤.٠	٨٥.٠±٤.٣	٠.٦٦٩
٥ min AS	٨٣.٢±٢.٥*	٨٣.٠±٣.٧*	٨١.٣±٣.٧*	٨٢.٢±٣.٢*	٠.٠٨٥
١٠ min AS	٨٣.٠±٣.١*	٨٢.٦±٤.١*	٨٠.٠±٤.١*	٨٠.٢±٣.٣*	٠.٢٢٢
١٥ min AS	٨٢.٨±٢.٨*	٨٠.٢±٢.١*	٧٩.٠±٣.١*	٧٩.١±٣.٢*	٠.١٤٩
٣٠ min AS	٨٥.٠±٣.٠*	٨٥.١±٢.٣*	٨٦.٠±٤.٠*	٨٤.٠±٣.٨*	٠.١٨٦
٤٥ min AS	٨٧.٣±٢.٧	٨٧.٢±٣.٤	٨٨.٤±٣.٢	٨٦.٠±٤.٠	٠.٣١٤
٦٠ min AS	٨٩.٥±٢.٨	٨٩.٦±٤.١	٩٠.٤± ٣.٦	٨٨.٠±٣.٧	٠.٣٦٦

AS, after spinal anesthesia. * Significant between the given time and baseline value in each group. *p* value between the four groups. *P* value < ٠.٠٥ considered significant.

Table (٣): Comparison of the heart rate (beats/min) between the four groups.

	Group A (n=٣٣)	Group B (n=٣٣)	Group C (n=٣٣)	Group D (n-٣٣)	*P* value
Base line	٨٧.٦±٧.٣	٨٥.٣±٨.٩	٨٤.٦±٧.٤	٨٦.٢±٦.٢	٠.٤٠٤
١ min AS	٨١.٢±٥.٦	٨٠.٢±٦.١	٧٨.٣±٤.١	٧٩.١±٤.٢	٠.١٠٩
٥ min AS	٧٨.٣±٤.٧*	٧٦.٣±٤.٥*	٧٤.١±٣.١*	٧٤.٢±٣.٨*	٠.٢٨٣
١٠ min AS	٧٧.١±٣.٢*	٧٤.٢±٤.١*	٧٢.٠±٢.٤*	٧١.٣±٢.٦*	٠.٤٢٥
١٥ min AS	٧٥.٦±٦.٤*	٧٢.١±١.٨*	٧٠.٧±٣.١*	٦٧.٢±٣.٧*	٠.٣٨٠
٣٠ min AS	٧٩.٠±٦.١*	٧٩.٢±٢.٦*	٧٩.١±٢.٩ *	٦٦.٣±٤.٣*	٠.١٦٩
٤٥ min AS	٨٠.٠±٤.٥	٨٠.٩±٣.١	٨١.١±٤.٠	٧٥.١±٤.٧*	٠.٠٩٨
٦٠ min AS	٨١.٠±٥.١	٨٢.٠±٣.٠	٨٣.٠±٣.١	٧٧.٤±٣.٥*	٠.١٠٣

AS, after spinal anesthesia. * Significant between the given time and baseline value in each group. *p* value between the four groups. *P* value < ٠.٠٥ considered significant.

Table (٤): characters of spinal anesthesia

Item	Group A (n=٣٣)	Group B (n=٣٣)	Group C (n=٣٣)	Group D (n-٣٣)	*P* value
Onset of sensory block (min)	٧.٢±١.٩	٩.٤±٢.٣*†	٩.٩±٢.١*†	٥.٣±١.٢*	٠.٠٠١
Duration of sensory block (min)	١٧٠±٢٣	١٩٢±١٨.١*	١٩٩±١٧.٣*	١٩٨±١٥.١*	٠.٠٠١
Onset of motor block(min)	٨.٨±٢.١	١١.٣±٢.٦*†	١٢.١±٢.٧*†	٧.١±١.٩*	٠.٠٠١
Duration of motor block(min)	١٢٢±١٨.١	١٥٠±١٩.٢*	١٥٧±٢٠.١*	١٥٣±١٨.٦*	٠.٠٠١
Time to ١st analgesic request (min)	١٨٨±١١.٢	٢١٨±١٧.١*	٢٤٥±١٥.٤*†!	٢٣٥±١٥.٣*!	٠.٠٠١

* Significant to group A control group. † Significant to group D fentanyl group. ! Significant to group B magnesium ٥٠ mg. *P* value between the four groups.

Table (٥): side effects associated with spinal anesthesia in each group

Item	Group A (n=٣٣)	Group B (n=٣٣)	Group C (n=٣٣)	Group D (n-٣٣)	*P* value
Bradycardia	٨/٣٣	٩/٣٣	٩/٣٣	١٥/٣٣†	٠.٢٢٦
Hypotension	١٥/٣٣	١٠/٣٣	١١/٣٣	١٧/٣٣	٠.٠٥٣
Vomiting	٣/٣٣	٢/٣٣	٣/٣٣	٤/٣٣	٠.٨٦٥
Pruritus	٠/٣٣	٠/٣٣	٠/٣٣	٩/٣٣†	٠.٠٠١

†Significant to group D fentanyl group. *P* value between the four groups.

Discussion

Magensium is non-competitive N-methyl D- aspartate (NMDA) receptor antagonist and inhibits voltage -gated calcium channels[١١]. Administration of magnesium decreases C- fibers activation through inhibiting slow excitatory post synaptic currents produced by activation of NMDA receptors present in dorsal horn of spinal cord and suppresses nociceptive impulse in neuropathic pain, and increases opioids antinociception[١٢]. Safety of subarachnoid magnesium administration was examined in animal studies such as chanimov et al.,[١٣] research in which ١.٢٦ mg bolus subarachnoid dose of magnesium was administered in rats on alternate days over a month and they found this dose produced transient motor and sensory block similar to subarachnoid lidocaine with no neurological deficit as shown by clinical examination and histological examination of spinal cord in rats. Simpson et al.,[١٤] in their randomized controlled study administered ٣mg/kg magnesium in the subarachnoid space of dogs before aortic cross clamping and they found that no dog had neurological deficit as evidenced by histopathological examination, this means not only the safety of subarachnoid magnesium but also it can protect against ischemic injury. The dos of ٣mg/kg (٤٥-٦٠ mg) of subarachnoid magnesium in dogs was extrapolated to ٤٥٠-٦٥٠ mg in human with considering the difference in the body weight and cerebrospinal fluid volume between human and dogs.

The dose of subarachnoid magnesium based on clinical finding from rat model of post-operative pain in Kroin et al., [١٥] research in which they concluded that ٢٨١µg of subarachnoid magnesium potentiated morphine antinociception and based on the difference in cerebrospinal fluid volume in rats and human, this dose was extrapolated to ٥٠ mg in human. It was based also on Buvanendran et al.,[١٦] research which was the first randomized controlled trial investigating the effect of intrathecal magnesium as adjuvant to intrathecal fentanyl in labor analgesia in which they used ٥٠ mg of intrathecal magnesium.

Khalili et al.,[١٧] in their study to evaluate the effects of adding intrathecal magnesium as adjuvant for spinal anesthesia in lower extremity surgery and they used a dose of

١٠٠ mg magnesium and they concluded that no more benefits of the dose of ١٠٠ mg over ٥٠ mg in its effect in prolongation of sensory, and motor block. Jabalameli et al.,[١٨] in their study to compare between different doses of intrathecal magnesium for spinal anesthesia in cesarean section and they found that the best dose of intrathecal magnesium was ٧٥ mg to obtain the best benefits with the least side effects. In the current study two doses of magnesium were chosen ٥٠ mg and ٧٥ mg for intrathecal use. As regards the onset and duration of sensory and motor block of spinal anesthesia, this study found magnesium delayed onset of sensory and motor block even more than the control group, the delay was more in the group of ٧٥mg, and it found that magnesium prolonged the duration of spinal anesthesia which was more in the group of ٧٥ mg group but still less than fentanyl group. Buvanendran et al.,[١٦] in their study found this dose to prolong the analgesia without side effects and they also found that the baricity (measured by refractometer) of local anesthetic solution which contain magnesium significantly affect the onset and duration of spinal anesthesia, They found that hyperbaric solution (compared to cerebrospinal fluid specific gravity) which result from adding magnesium to hyperbaric bupivacaine would increased the duration of spinal anesthesia while when adding magnesium to isobaric bupivacine would decrease the duration of spinal anesthesia. The current study used hyperbaric bupivacaine ٠.٥٪ so it was suspected to have hyperbaric solution and prolonged duration of spinal anesthesia.

This was in agree with the results of Sunil et al.,[١٩] in their study to compare between multiple adjuvants to local anesthetics in subarachnoid block and they noticed delay in the onset of sensory and motor block in magnesium group more than fentanyl group. Also this was in agree with Malleeswaran et al.,[٢٠] who examined ٥٠ mg of intrathecal magnesium as adjuvant to intrathecal bupivacaine ١٠ mg and fentanyl ٢٥ µg in mild preeclampsia and they noticed that intrathecal magnesium delayed the onset of spinal anesthesia and they prolong duration of spinal anesthesia. Ozalveli et al.,[٢١] in their clinical trial on ١٠٢ patients scheduled for lower limb surgery under spinal anesthesia and they found that ٥٠ mg of intrathecal magnesium would delay onset of sensory and motor block and prolong duration of spinal anesthesia produced by ١٠ mg bupivacaine and ٢٥ µg fentanyl and they explained this by the difference in baricity and pH of the magnesium containing solution.

Nath et al.,[٢٢] in their study to evaluate efficacy and safety of intrathecal ١٠٠ mg of magnesium as adjuvant to bupivacaine ٠.٥% in subarachnoid block for hysterectomy found that there was a delay in the onset of sensory and motor block and they referred this results to the changes of pH of local anesthetic solution and they concluded that magnesium had a good safety profile.

Dayioglu [٢٣] in their study to evaluate the effects of ٥٠ mg of intrathecal magnesium as adjuvant to bupivcaine ٠.٥٪ and fentanyl in knee arthroscopy and they found that there was prolongation of time to two segments regression without affecting the time of complete motor recovery.

Kherzi et al.,[٢٤] in their study in which they compared between intrathecal ٥٠ mg magnesium and ٢٥ µg fentanyl as adjuvant to hyperbaric bupivacaine ١٥ mg in subarachnoid block for lumber lower limb orthopedic surgery and they found that magnesium delayed onset of both sensory and motor block compared to fentanyl and prolonged the duration of spinal analgesia with subsequent decrease in the analgesic consumption.

Jabalameli et al.,[١٨] in their study to compare between different doses of intrathecal magnesium for spinal anesthesia for cesarean section and they found that addition of magnesium would delay onset of sensory and motor block but prolonged the duration of spinal analgesia. These effects increased with increase in the dose of magnesium but side effects like nausea, vomiting, and hypotension began to appear at a dose of ١٠٠ mg intrathecal magnesium. On the other hand Unlugenc and colleagues[٢٥] concluded that magnesium had no effects on the onset of spinal

anesthesia while fenatanyl produce high level of sensory block with rapid onset more than magnesium and they explained this by the supraspinal action of fentanyl beside its spinal action at opioid receptors in the dorsal horn while magnesium had spinal action only and cannot pass the blood brain barrier, also they reported that magnesium decreased the duration of spinal analgesia by ١٩ minutes which could be explained rapid removal of magnesium from cerebrospinal fluid. Otukomi et al.,[٢٦] explained the delayed onset of local anesthetic mixture containing magnesium by the stimulation of cytochrom P٤٥٠ enzyme which responsible of hydroxylation and metabolism of bupivacaine. As regards safety and side effects of intrathecal magnesium the current study found that intrathecal magnesium was not associated with serious side effects as respiratory depression, excessive sedation, nausea, and vomiting. This was in agree with Arcioni et al.,[٢٧] in their study for evaluation the effect of combined intrathecal and epidural magnesium sulphate on postoperative analgesic requirements, they reported that intrathecal use of magnesium was not associated with serious side effects such as systemic toxicity, hypotension, arrhythmia, somnolence, slurred speech neither intra-operative nor postoperative.

Conclusion

This study concluded that intrathecal magnesium sulphate when used as adjuvant to hyperbaric bupivacaine ٠.٥٪ in lower limb surgeries delayed the onset of spinal anesthesia (both sensory and motor block) and prolonged the duration of spinal anesthesia. These effects increased with increase the dose of intrathecal magnesium from ٥٠mg to ٧٥mg. Intrathecal magnesium was associated with less incidence of side effects than fentanyl and control groups.

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