ORIGINAL ARTICLE

The effects of magnesium sulphate on succinylcholine-induced fasciculation during induction of general anaesthesia

Behzad Ahsan,[1] Ezatollah Rahimi,[2] Afshin Moradi,[3] Naser Rashadmanesh[4]

Abstract

Objectives: To investigate the effects of magnesium sulphate on succinylcholine-induced fasciculation in patients during the induction of general anaesthesia.

Methods: The double-blind randomised clinical trial was conducted in 2012 at Tohid and Besat Hospitals in Sanandaj, Iran, on patients who were candidates for surgery under general anaesthesia. Patients were selected and divided into two equal groups of cases and controls using block randomisation. The cases received magnesium sulphate, while the controls received normal saline. SPSS 18 was used for statistical analysis.

Results: Of the 100 subjects in the study, 49(49%) were men and 51(51%) were women ($p<0.072$). The mean age of the two groups were 37.5±12.2 years and 37.7±12 years ($p<0.9$). There was significant difference between the two groups in terms of the degree of fasciculation and muscle fasciculation ($p<0.001$). The difference between potassium levels in the two groups was not significant before anaesthesia ($p>0.05$), but it was significant after anaesthesia ($p<0.001$).

Conclusions: Magnesium sulphate can prevent and reduce the degree of fasciculation after anaesthesia. Therefore it can be used to prevent fasciculation.

Keywords: Magnesium sulphate, Muscle fasciculation, Succinylcholine, anaesthesia induction. (JPMA 64: 1151; 2014)

Introduction

Succinylcholine is a depolarising muscular relaxant which is used to facilitate endotracheal intubation. It is used with non-depolarising neurological blockers that have a relatively short effect in terms of tracheal intubation.[1] One of its adverse effects is the transient fasciculation after injection which is associated with some other complications of succinylcholine.[2] Along with the many benefits of using this medication, it can develop some complications like neurological muscle fasciculation. In addition to muscle fasciculation, this medication may also increase postoperative myalgia due to increased phosphokinase.[3]

The pathophysiology of fasciculation is unclear, but it may be induced by axonal depolarisation caused by the connection between succinylcholine and presynaptic and cholinergic nicotinic receptors. Postoperative muscle damages and myalgia are attributed to different mechanisms, including increased myoplasmic calcium concentration, changes in membrane phospholipids, releasing free fatty acids and the involvement of free radicals.[4-6] Therefore, various methods and drugs have been suggested for the prevention of these complications. Magnesium sulphate is one of the drugs that has recently been investigated largely,[7-10] but there is still a lot of controversy.[11]

Magnesium acts as an adrenergic antagonist and inhibits the release of catecholamine. So it probably controls the undesirable effects of laryngoscopy for tracheal intubation such as increased heart rate, increased blood pressure, and increased intraocular pressure.[2,12] On the other hand, magnesium sulphate reduces the negative effects caused by succinylcholine and avoids the increase of potassium (K) concentration after administration of Sachs. Furthermore, using magnesium sulphate before tracheal intubation relieves the haemodynamic response.[2,9] Magnesium sulphate is also effective in reducing pain after the administration of succinylcholine.[9] Nevertheless, there are few studies investigating this drug and it has not been routinely used. Therefore, this study was planned to assess the effects of magnesium sulphate on muscle fasciculation caused by succinylcholine in patients during the induction of anaesthesia.

Patients and Methods

The double-blind randomised clinical trial was conducted in 2012 at Tohid and Besat Hospitals in Sanandaj, Iran, on patients who were candidates for surgery under general anaesthesia. Patients classified as American Society of Anaesthesiologists (ASA) I and II going for elective surgery

[1,3]Department of Anesthesiology, [2,4]Research Center for Gastroenterology and Hepatology, School of Medicine, Kurdistan University of Medical Sciences, Sanandaj, Iran.

Correspondence: Ezatollah Rahimi. Email: dr.erahimi@muk.ac.ir

between the ages of 18 and 60 years were included. Exclusion criteria comprised pregnancy, emergency surgery, history of muscular disease, history of hyperthermia malignant, contraindications of succinylcholine, patients taking calcium channel blockers or beta blockers, hypotension, hypoparathyroid and hypocalcaemia.

A pilot study was conducted on 20 patients to determine the sample size. According to the results of the pilot, mean of fasciculation grade in normal saline and magnesium sulphate groups were 2.4±1.8 and 1.1±1.4 respectively. In the light of the result, assuming type I error of 5% and power of the study being 95%, the sample size was calculated to be 41 participants in each of the two groups. Our final study sample size was 100 which was divided into two equal groups of cases and controls using block randomisation (5 blocks each).

The intervention group received 4mg/kg of magnesium sulphate in 100cc of normal saline infused in five minutes. It was started 6.5 minutes before anaesthesia and was completed approximately 1.5 minutes before the induction of anaesthesia. The controls received 100cc of normal saline without magnesium sulphate in five minutes which was infused 6.5 minutes before the induction of anaesthesia. The participating anaesthesiologist was unaware of patients' group and so were the patients themselves.

Fasciculation was measured immediately, 10 minutes and 30 minutes after the administration of succinylcholine. 'No visible fasciculation' was termed Nil and scored 0; 'Very fine fingertip or facial muscle movements', Mild and 1; 'Minimal fasciculation on trunk and extremities', Moderate and 2; and 'Vigorous fasciculation on trunk and extremities', Severe and 3.5

Informed consent was obtained from all the subjects and in case of any adverse side effects, the drug administration was stopped and it was replaced with calcium gluconate. Data were entered into SPSS 18 and was analysed using Mann-Whitney U test and Chi-square test.

Results

The mean age of the cases and control groups were 37.5±12.2 years and 37.7±12 years (p<0.9). There were 49(49%) men and 51(51%) women in the study (p<0.072). Overall, 78(78%) patients were classified as ASA-I (p<0.334).

After the intervention, fasciculation was observed in 4(8%) patients among the cases and 45(90%) among the controls (p<0.001). Fasciculation grade in the intervention group was significantly lower than that in the control group (p<0.001). The difference between K levels in the two groups was not significant before anaesthesia (p>0.05), but it was significant after anaesthesia (p<0.001).

Table: Comparison of the baseline and outcome variables between the two groups.

Variables	Magnesium Sulphate	Normal Saline	P-value
Sex			
Male	20 (40%)	29 (58%)	0.072
Female	30 (60%)	21 (42%)	
ASA			
I	41 (82%)	37 (74%)	0.334
II	9 (18%)	13 (26%)	
Fasciculation Grade			
0	46 (92%)	0	< 0.001
1	4 (8%)	10 (20%)	
2	0	25 (50%)	
3	0	15 (30%)	
Fasciculation	4 (8%)	45 (90%)	< 0.001
Grade of Fasciculation (mean±SD)	0.08 (±0.3)	2.1 (±0.7)	< 0.001
K level before intervention (mean±SD)	3.5 (±0.07)	3.5 (±0.06)	0.147
K level after intervention (mean±SD)	3.5 (±0.08)	3.9 (±0.1)	< 0.001

Comparison of sex and ASA distribution between the two groups was evaluated using Chi-square test. Comparison of quantitative variable and fasciculation grade between the two groups was evaluated using Mann-Whitney U test.
ASA: American Society of Anaesthesiologists.
K: Potassium.

Besides, K level in the cases was reduced after the intervention compared with the time before the intervention, while it increased in the controls (p<0.001) (Table).

Discussion

In this study, both the cases and the controls had similar baseline characteristics. Therefore, the findings are the results of the intervention. Based on the results, magnesium sulphate can greatly reduce the muscle fasciculation caused by succinylcholine used for the induction of anaesthesia. Other drugs are also suggested for the prevention of post-anaesthesia fasciculation, but these drugs may not be available in certain countries or may be very expensive.[1-13] Therefore, using magnesium sulphate would be less expensive and more useful.

Based on the results of our study, fasciculation was observed in 8% of magnesium sulphate group and 90% of placebo group. In one study[10] 50% of the study subjects who had received magnesium sulphate did not experience fasciculation, while in saline group all patients experienced fasciculation. In another study[14] after the administration of magnesium sulphate and thiopentone, no case of fasciculation was observed in patients who had succinylcholine-induced anaesthesia.

One study[12] on the effects of propofol on succinylcholine-induced fasciculation reported that 20% of people in the propofol group did not experience any type of fasciculation and none of them experienced severe fasciculation. In a meta-analysis[7] fasciculation was observed in 95% patients in the placebo group and 50% in the intervention group. It concluded that lidocaine and magnesium sulphate were more effective than other drugs. Another study[2] also showed that magnesium sulphate is useful both for reducing fasciculation and lowering blood pressure and heart rhythm disturbances during anaesthesia. In their study, 33% of the magnesium sulphate group did not experience fasciculation at all.

Studies have also shown magnesium sulphate to have beneficial effects on postoperative pain relief.[15] One study[10] investigated the effect of magnesium sulphate on fasciculation induced by intravenous injection of succinylcholine, and found that in the group that received magnesium sulphate the degree of fasciculation was significantly lower than the control group.

In another study, magnesium sulphate not only reduced fasciculation, but also prevented the undesirable haemodynamic changes such as increased heart rate and blood pressure.[2] Since most of the studies confirm the positive effects of magnesium sulphate on fasciculation, it can, therefore, be suggested that magnesium sulphate should be used to prevent fasciculation which is common in most cases.

Other studies that investigated the effects of magnesium sulphate on reducing fasciculation after using anaesthetic drugs, demonstrated that magnesium sulphate can reduce the severity of fasciculation.[16] Moreover, magnesium sulphate can also reduce movements during anaesthesia. In a study, anaesthetic action was observed in 76% of the control group and 44% of the magnesium sulphate group. Magnesium sulphate is a natural calcium channel blocker and can have anti-nociceptive effects; therefore, it can be a useful drug during and after anaesthesia.[9,17,18]

In terms of limitations, the study did not investigate the side effects of magnesium sulphate since it is frequently used in eclampsia and preeclampsia in pregnant women and is considered a safe drug. One of its side effects is the reduction of K levels.[2] However, there was no particular side effects in the administered dose and it was safe.[10]

Conclusion

Magnesium sulphate can prevent and reduce the degree of fasciculation after anaesthesia. Therefore it can be used to prevent fasciculation.

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