ORIGINAL RESEARCH

Effect Of BMI On Levels Of Serum Magnesium In Subjects On Pritchard Regimen

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Abstract
Background: Maternal mortality from severe eclampsia and preeclampsia has reduced significantly in developed nations from revolutionary management by magnesium sulfate, however, it is high in developing nations such as India. Various factors including BMI can significantly affect serum magnesium levels in subjects getting therapeutic and prophylactic management using the Pritchard regimen.
Aim: The present study aimed to assess the effect of BMI (Body mass index) on serum magnesium levels in Pritchard regimen subjects and magnesium sulfate therapy subjects for prophylaxis of seizures.
Methods: The present study assessed 320 subjects with severe preeclampsia and eclampsia who were under the Pritchard regimen within the defined study period. In all the included subjects, serum magnesium levels were assessed after the loading dose, the third dose, and 24 hours after the last dose. Subjects were divided into various groups based on the WHO BMI category. The data gathered were statistically analyzed.
Results: The study results showed that following loading dose, mean serum magnesium levels in subjects for BMI <18.5, 18.5-24.99, 25-29.99, and ≥30 were 3.89±1.07, 3.40±0.95, 3.18±0.79, and 2.75±0.65 mg/dl respectively. However, the difference was statistically non-significant with p=0.0614 and serum magnesium level decrease was seen with increased BMI. Following 3rd dose, the mean serum magnesium level was 6.74±0.93, 6.32±1.13, 5.811.00, and 5.56±0.98mg/dl for BMI <18.5, 18.5-24.99, 25-29.99, and ≥30 respectively with statistically significant difference and p=0.0001. Higher convulsion rates were seen in obese subjects compared to non-obese subjects with 13.04% and 2.91% subjects respectively.
Conclusion: The present study concludes that BMI plays a significant role in serum magnesium levels in pregnant females under magnesium sulfate therapy for seizure prophylaxis.
Keywords: BMI, convulsion, serum magnesium level, seizures

Introduction

BMI (body mass index) in a subject is an assessment of the body fat depending on the weight and height. It is calculated as weight in kg divided by height in meters. Following WHO, a subject with a BMI <18.5 is considered underweight, 18.5-24.99 is taken as normal, 25-29.99 is overweight, and above 30 is considered obese. In the earth's crust, the 8th most prevalent element is magnesium with rivers and oceans as the most abundant source of physiologically unstable magnesium. The mean magnesium in the human body is nearly 20mmol in 1 kg fat tissue. 99% of total body magnesium is seen in non-muscular soft tissues, muscles, and bones. Nearly 1% of body magnesium is extracellular primarily seen in red blood cells and serum free, bound to proteins, ionized, or in complexes.[1]

One of the most vital uses of magnesium is in the prevention of eclampsia, preeclampsia, and convulsions with MgSO4 (magnesium sulfate) showing few complications and more efficacy than other drugs.Pritchard regimen (1955) is accepted widely for MgSO4 administration via the intravascular/intramuscular route. 40% magnesium is protein-bound, and unbound ions diffuse to extracellular and extravascular space, bone, and other tissues and diffuse on fetal membranes and placenta to amniotic fluid. In pregnant females, the distribution volume is 0.250-0.442 L/kg and usually reaches consistent levels within 3-4 hours of administration. Kidneys are vital for magnesium homeostasis as

magnesium is primarily excreted in urine. Almost all administered magnesium is excreted in urine with 90% excreted in the first 24 hours of MgSO4 infusion. Presently, serum magnesium <4.8mg/dl is considered subtherapeutic with 4.8-8.4 as therapeutic, and >8.4 as supra-therapeutic.[2]

Gestational hypertension is taken as blood pressure ≥140/90 mmHg on 2 occasions for a minimum 4 hours apart after 20 weeks of gestation in females with previously normal blood pressure, preeclampsia as a pregnancy-specific disease with de-novo concurrent proteinuria and hypertension development occasionally progressing to a multiorgan cluster of varying clinical features. However, in preeclampsia, proteinuria is the most vital feature, hypertension can also be seen without proteinuria. Severe preeclampsia is a blood pressure of 160/110 or more on two occasions minimum 4 hours apart (unless start of antihypertensive therapy before diagnosis) with one/more clinical features such as pulmonary edema, renal insufficiency (serum creatinine concentration of more than 1.1 mg/dL or a doubling of the serum creatinine concentration in the absence of other renal disease), impaired liver function, and/or thrombocytopenia. Eclampsia is one/more tonic-clonic generalized seizures in pregnant females with hypertensive disorders not related to any other medical disease.[3]

Common maternal complications seen in eclampsia and preeclampsia subjects include maternal death, DIC, HELLP syndrome, pulmonary embolism, pulmonary edema, renal dysfunction, abruptio placentae, and PPH. Common fetal complications are birth asphyxia, IUFD, IUGR, low birth weight babies, and preterm deliveries. Subjects with high BMI have a large distribution volume with low BMI leading to subtherapeutic levels in very high BMI and toxicity with very low BMI.[4]

Substantial literature data is present on the effect of BMI, toxicity, therapeutic range, and dosing pattern from various parts of the world, existing literature data is scarce on the effect of BMI on serum magnesium levels. It is vital to conduct studies to assess the effect of BMI on serum magnesium levels following the Pritchard regimen to attain better management of subjects with eclampsia and preeclampsia.[5] Hence, the present study aimed to assess the effect of BMI (Body mass index) on levels of serum magnesium in subjects on the Pritchard regimen in subjects on magnesium sulfate therapy for prophylaxis of seizure.

Materials and methods

The present prospective assessment study was aimed to assess the effect of BMI (Body mass index) on levels of serum magnesium in subjects on the Pritchard regimen in subjects on magnesium sulfate therapy for prophylaxis of seizure. The study subjects were from the Department of Radiodiagnosis of the Institute. Verbal and written informed consent were taken from all the subjects before participation.

The study included 320 pregnant females 240 females with eclampsia and 80 females with severe preeclampsia that visited the labor room or antenatal OPD of the Institute within the defined study period.

The inclusion criteria for the study were subjects who were admitted to the Institute within the defined study period, subjects with eclampsia or severe preeclampsia, subjects getting treatment following the Pritchard regimen, and subjects willing to participate in the study. The exclusion criteria for the study were subjects that previously were on other anticonvulsants, allergic to magnesium sulfate, had chronic liver disease, renal disease, family/personal history of myasthenia gravis, and pregnant females that had magnesium sulfate loading dose of Pritchard regimen more than 4 hours before presenting.

After the final inclusion of the study subjects, magnesium sulfate injection was given following the Pritchard regimen as 16.4 grams in 20% w/v of magnesium sulfate intravenous over five minutes followed by administration of 10 grams 50% w/v deep intramuscular followed by 5 grams every four hours in upper outer quadrant in alternate buttock after ascertaining respirations not less than 12/min, urine flow of 100ml or more in last 4 hours, and presence of knee jerk (patellar reef). 31mm length needle of 22 gauze was used for intramuscular injection.

The data gathered were analyzedstatistically using SPSS (Statistical Package for the Social Sciences) software version 24.0 (IBM Corp., Armonk. NY, USA) for assessment of descriptive measures, Student t-test, ANOVA (analysis of variance), and Chi-square test. Pearson correlation coefficient was used to assess correlation in various parameters. The results were expressed as mean and standard deviation and frequency and percentages. The p-value of <0.05 was considered.

Results

The present prospective assessment study was aimed to assess the effect of BMI (Body mass index) on levels of serum magnesium in subjects on the Pritchard regimen in subjects on magnesium sulfate therapy for prophylaxis of seizure. The present study assessed 320 subjects with severe preeclampsia and eclampsia who were under the Pritchard regimen within the defined study period. Among 50.63% (n=162) subjects in the age range of 20-24 years followed by 36.25% (n=116) subjects in <20 years, 9.38% (n=30) subjects in 25-30 years, and least 3.75% (n=12) subjects in >30 years. For distribution of cases based on the BMI, there were 22.5% (n=18), 47.5% (n=38), 20% (n=16), and 10% (n=8) subjects with BMI <18.5, 18.5-24.99, 25-29.99, and >30 kg/m2 in pre-eclampsia and 26.67% (n=64), 48.33% (n=116), 9.17% (n=22), and 15.83% (n=38) subjects with BMI <18.5, 18.5-24.99, 25-29.99, and >30 kg/m2 in eclampsia group. In total. There were

25.63% (n=82), 48.13% (n=154), 11.88% (n=38), and 14.36% (n=46) subjects with BMI <18.5, 18.5-24.99, 25-29.99, and >30 kg/m2 respectively (Table 1).

It was seen that for correlation of serum magnesium level with BMI in study subjects after loading, in BMI <18.5, mean serum magnesium level was 3.89±1.07mg/dl followed by decrease to 3.40±0.95, 3.18±0.79, and 2.25±0.65 for BMI of 18.5-24.99, 25-29.99, and >30 kg/m2 respectively depicting statistically non-significant results with p=0.0614 (Table 2). On assessing the serum magnesium level in study subjects with varying BMI after 3rd dose in BMI <18.5, mean serum magnesium level was 6.74±0.93 mg/dl which decreased significantly with increase in BMI to 6.32±1.13, 5.81±1.00, and 5.56±0.98with BMI of 18.5-24.99, 25-29.99, and >30 kg/m2 respectively which was statistically significant with p=0.0001 (Table 3).

The study results showed that for serum magnesium levels after 24 hours of dose in study subjects with different BMI, mean serum magnesium level after 24 hours for BMI <18.5 kg/m2 was 3.54±0.84 which decreased to 3.27±0.92 for BMI of 18.5-24.99 kg/m2, 3.24±0.94 for BMI of 25-29.9 and to 3.09±1.11 mg/dl for BMI of >30 kg/m2. This decrease was statistically non-significant with p=0.2456 (Table 4).

It was also seen that for several subjects having convulsions during treatment, there were 4.37% (n=14) with convulsions in the study with no subject with convulsion in preeclampsia and 5.83% (n=14) subjects with convulsions in eclampsia group (Table 5). For the relationship of convulsion and BMI in study subjects, for BMI <30kg/m2, there were 274 subjects with 2.92% (n=8) subjects with convulsions and for BMI ≥30 kg/m2, there were 13.04% (n=6) subjects with convulsions among 46 subjects (Table 6).

S. No	BMI	Pre-eclampsia		Eclampsia		Total	
		n=80	%	n=240	%	n=320	%
1.	<18.5	18	22.5	64	26.67	82	25.63
2.	18.5-24.99	38	47.5	116	48.33	154	48.13
3.	25-29.99	16	20	22	9.17	38	11.88
4.	>30	8	10	38	15.83	46	14.36

Table 1: Distribution of cases based on the BMI

S. No	BMI	Mean serum magnesium level (mg/dl)	p-value
1.	<18.5	3.89±1.07	0.0614
2.	18.5-24.99	3.40±0.95	
3.	25-29.99	3.18±0.79	
4.	>30	2.25±0.65	

Table 2: Correlation of serum magnesium level with BMI in study subjects after loading

S. No	BMI	Mean serum magnesium level (mg/dl)	p-value
1.	<18.5	6.74±0.93	**0.0001**
2.	18.5-24.99	6.32±1.13	
3.	25-29.99	5.81±1.00	
4.	>30	5.56±0.98	

Table 3: Serum magnesium level in study subjects with varying BMI after 3rd dose

S. No	BMI	Mean serum magnesium level (mg/dl)	p-value
1.	<18.5	3.54±0.84	0.2465
2.	18.5-24.99	3.27±0.92	
3.	25-29.99	3.24±0.94	
4.	>30	3.09±1.11	

Table 4: Serum magnesium levels after 24 hours of dose in study subjects with different BMI

S. No	Category	Total		Preeclampsia		Eclampsia	
		n=320	n=320	n=80	%	n=240	%
1.	Subjects with convulsions	14	4.37	0	0	14	5.83
2.	Subjects without convulsions	306	95.63	80	100	226	94.17

Table 5: Subjects having convulsions during treatment

S. No	BMI	Number	Convulsion	Percentage
1.	<30	274	8	2.92
2.	≥30	46	6	13.04

Table 6: Relationship of convulsions and BMI in study subjects

Discussion

The present study assessed 320 subjects with severe preeclampsia and eclampsia who were under the Pritchard regimen within the defined study period. Among 50.63% (n=162) subjects in the age range of 20-24 years followed by 36.25% (n=116) subjects in <20 years, 9.38% (n=30) subjects in 25-30 years, and least 3.75% (n=12) subjects in >30 years. For distribution of cases based on the BMI, there were 22.5% (n=18), 47.5% (n=38), 20% (n=16), and 10% (n=8) subjects with BMI <18.5, 18.5-24.99, 25-29.99, and >30 kg/m2 in pre-eclampsia and 26.67% (n=64), 48.33% (n=116), 9.17% (n=22), and 15.83% (n=38) subjects with BMI <18.5, 18.5-24.99, 25-29.99, and >30 kg/m2 in eclampsia group. In total. There were 25.63% (n=82), 48.13% (n=154), 11.88% (n=38), and 14.36% (n=46) subjects with BMI <18.5, 18.5-24.99, 25-29.99, and >30 kg/m2 respectively. These data were comparable to the previous studies ofDayicioglu V et al[6] in 2003 and Brookfield KF et al[7] in 2020 where authors assessed pregnant subjects with demographic and disease data comparable to the present study in their respective studies.

The study results showed that for correlation of serum magnesium level with BMI in study subjects after loading, in BMI <18.5, mean serum magnesium level was 3.89±1.07mg/dl followed by decrease to 3.40±0.95, 3.18±0.79, and 2.25±0.65 for BMI of 18.5-24.99, 25-29.99, and >30 kg/m2 respectively depicting statistically non-significant results with p=0.0614. On assessing the serum magnesium level in study subjects with varying BMI after 3rd dose in BMI <18.5, mean serum magnesium level was 6.74±0.93 mg/dl which decreased significantly with increase in BMI to 6.32±1.13, 5.81±1.00, and 5.56±0.98with BMI of 18.5-24.99, 25-29.99, and >30 kg/m2 respectively which was statistically significant with p=0.0001. These results were consistent with the findings of Taye MK et al[8] in 2022 and Tudela CM et al[9] in 2013 where the correlation of serum magnesium level with BMI in pregnant subjects reported by the authors in their studies was comparable to the results of the present study.

It was seen that for serum magnesium levels after 24 hours of dose in study subjects with different BMI, mean serum magnesium level after 24 hours for BMI <18.5 kg/m2 was 3.54±0.84 which decreased to 3.27±0.92 for BMI of 18.5-24.99 kg/m2, 3.24±0.94 for BMI of 25-29.9 and to 3.09±1.11 mg/dl for BMI of >30 kg/m2. This decrease was statistically non-significant with p=0.2456. These findings were in line with the results of Fishel Bartal M et al[10] in 2022 and Homer CSE et al[11] in 2008 where serum magnesium levels after 24 hours of dose comparable to the present study were also reported by the authors in their respective studies.

The study results also showed that for several subjects having convulsions during treatment, there were 4.37% (n=14) with convulsions in the study with no subject with convulsion in preeclampsia and 5.83% (n=14) subjects with convulsions in eclampsia group. For the relationship of convulsion and BMI in study subjects, for BMI <30kg/m2, there were 274 subjects with 2.92% (n=8) subjects with convulsions and for BMI ≥30 kg/m2, there were 13.04% (n=6) subjects with convulsions among 46 subjects. These results correlated with the findings of Singhal SR et al[12] in 2009 and Steegers EAP et al[13] in 2010 where convulsion data similar to eclampsia and preeclampsia reported by the authors in their studies was similar to the results of the present study.

Conclusions

The present study, considering its limitations, concludes that BMI plays a significant role in serum magnesium levels in pregnant females under magnesium sulfate therapy for prophylaxis of seizure. However, further longitudinal and prospective studies are needed in the future with a larger sample size and longer monitoring to reach a definitive conclusion.

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