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Effect of Magnesium Sulfate as Seizure Prophylaxis in Severe Preeclampsia Patients at Dr. M. Djamil General Hospital, Padang (February–April 2024)

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ABSTRACT:
Severe preeclampsia is a major contributor to maternal morbidity and mortality. Magnesium sulfate ($MgSO_4$) is widely used as the first-line agent for seizure prophylaxis, yet variations in concentration remain in clinical practice. This prospective, non-experimental study aimed to evaluate the effectiveness of different $MgSO_4$ concentrations in preventing seizures among patients with severe preeclampsia. The study was conducted at the Obstetrics Inpatient Unit of Dr. M. Djamil General Hospital, Padang, from February to April 2024. A total of 27 patients meeting the inclusion criteria were enrolled using purposive sampling. Data were analyzed descriptively. Seizures occurred in two patients receiving $MgSO_4$ 20%, while no seizures were observed among patients receiving $MgSO_4$ 40%. These findings suggest that higher $MgSO_4$ concentration may provide better seizure prophylaxis in severe preeclampsia.

KEYWORDS: Severe preeclampsia; magnesium sulfate; seizure prophylaxis; pregnancy; maternal outcome

I. INTRODUCTION

Preeclampsia is a pregnancy-specific disorder characterized by placental dysfunction and a systemic maternal inflammatory response associated with endothelial activation and coagulation abnormalities. This condition may progress to eclampsia when seizures occur during pregnancy or the postpartum period, posing a serious threat to both maternal and fetal health. Severe preeclampsia is clinically defined by systolic blood pressure ≥160 mmHg and/or diastolic blood pressure ≥110 mmHg accompanied by proteinuria, with onset after 20 weeks of gestation (1). Hypertensive disorders of pregnancy remain a major cause of maternal morbidity and mortality worldwide, particularly in low- and middle-income countries. The World Health Organization (WHO) reported that approximately 800 women die every day due to complications related to pregnancy and childbirth, with nearly 99% of these deaths occurring in developing countries. Hypertension in pregnancy contributes to around 10% of maternal deaths globally and represents one of the leading causes of maternal and perinatal morbidity and mortality. In Indonesia, preeclampsia is the second leading cause of maternal mortality and affects approximately 5–8% of pregnancies. Regional data from West Sumatra demonstrate a persistently high maternal mortality rate associated with preeclampsia and eclampsia. Reports from the Provincial and City Health Offices indicate that preeclampsia–eclampsia has consistently been among the primary causes of maternal death in Padang, surpassing hemorrhage and infection in several reporting years (2,3). These findings underscore the significant burden of preeclampsia on maternal health outcomes in this region. Severe preeclampsia substantially increases the risk of adverse maternal and perinatal outcomes, including fetal growth restriction, preterm birth, and maternal seizures. The progression to eclampsia represents a medical emergency that requires immediate and effective seizure prophylaxis. Pharmacological management must therefore be safe, effective, and rational, considering that most drugs administered during pregnancy are capable of crossing the placental barrier and entering the fetal circulation (4). Magnesium sulfate ($MgSO_4$) is the first-line anticonvulsant recommended for the prevention and

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treatment of eclamptic seizures and has become the standard of care in obstetric practice. Numerous studies have demonstrated that $MgSO_4$ is more effective in preventing seizures and recurrent seizures compared with other anticonvulsant agents. The pharmacological mechanisms of $MgSO_4$ include vasodilation through smooth muscle relaxation, inhibition of N-methyl-D-aspartate (NMDA) receptors in the central nervous system, and reduction of neuronal excitability, thereby preventing seizure activity (2). In addition, $MgSO_4$ has been shown to reduce the risk of moderate to severe cerebral palsy in preterm infants without increasing adverse maternal or neonatal outcomes. Despite its widespread use, variations in $MgSO_4$ dosing and concentration persist in clinical practice, and their impact on seizure prevention outcomes has not been fully elucidated. Given the high burden of maternal mortality related to preeclampsia and eclampsia, as well as the critical role of $MgSO_4$ in seizure prophylaxis, further evaluation of its effectiveness is warranted. Therefore, this study aimed to assess the effectiveness of $MgSO_4$ administration in preventing seizures among patients with severe preeclampsia at Dr. M. Djamil General Hospital, Padang.

II. METHODS

Study Design
This study was a non-experimental prospective study designed to evaluate the effectiveness of magnesium sulfate ($MgSO_4$) concentrations in preventing seizures among patients with severe preeclampsia.

Study Site and Period
The study was conducted at the Obstetrics and Gynecology Inpatient Unit of Dr. M. Djamil General Hospital, Padang, Indonesia. Data collection was carried out prospectively from February to April 2024.

Population and Sample
The study population consisted of pregnant women diagnosed with severe preeclampsia who were hospitalized during the study period. Samples were selected using a purposive sampling technique. Inclusion criteria were pregnant women diagnosed with severe preeclampsia, receiving $MgSO_4$ therapy for seizure prophylaxis, and having complete medical records. Patients who received anticonvulsants other than $MgSO_4$ or had incomplete clinical data were excluded. A total of 27 patients met the inclusion criteria and were included in the analysis.

Intervention
All included patients received magnesium sulfate ($MgSO_4$) as anticonvulsant therapy according to hospital treatment protocols. Patients were categorized based on the concentration of $MgSO_4$ administered, namely 20% and 40%. $MgSO_4$ was administered immediately after the diagnosis of severe preeclampsia was established.

Data Collection
Data were collected prospectively from medical records and direct clinical monitoring. Collected variables included maternal demographic characteristics, blood pressure measurements, proteinuria status, $MgSO_4$ concentration administered, and the occurrence of seizures after therapy.

Outcome Measures
The primary outcome measured was the incidence of seizures following $MgSO_4$ administration. Secondary outcomes included the occurrence of recurrent seizures during hospitalization.

Data Analysis
Data were analyzed descriptively and presented as frequencies and percentages. The incidence of seizures was compared descriptively between patients receiving 20% and 40% $MgSO_4$ to assess differences in therapeutic response.

Ethical Approval
This study was conducted in accordance with ethical principles for clinical research. Ethical approval was obtained from the Ethics Committee of Dr. M. Djamil General Hospital. Patient confidentiality was ensured by anonymizing all identifiable information.

III. RESULTS AND DISCUSSION

This study describes the clinical characteristics of patients with severe preeclampsia and evaluates the effectiveness of different magnesium sulfate ($MgSO_4$) concentrations for seizure prophylaxis. The findings demonstrate that most patients were within the reproductive age group of 20–35 years and were diagnosed during the third trimester of pregnancy, Table 1.

Table 1. Demographic and Obstetric Characteristics of Patients with Severe Preeclampsia (n = 27)

Characteristic	Category	n	%
Age (years)	< 20	1	3.7

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Characteristic	Category	n	%
	20–35	17	62.9
	≥ 35	9	33.3
Gestational Age	Third trimester (28–41 weeks)	27	100
Parity	Nulliparous	8	29.6
	Primiparous	7	25.9
	Multiparous	10	37.0
	Grand multiparous	2	7.4

These results are consistent with recent epidemiological studies reporting that although advanced maternal age increases obstetric risk, the majority of preeclampsia cases occur among women of reproductive age due to higher pregnancy prevalence in this group (5,6). All cases in this study occurred in the third trimester, (Table.1) which aligns with current understanding of preeclampsia pathophysiology. Abnormal placentation and progressive endothelial dysfunction typically manifest clinically after 20 weeks of gestation, with disease severity increasing toward late pregnancy (7). Multiparous women constituted the largest proportion of cases, indicating that preeclampsia is not limited to primiparity alone, as previously suggested, but can occur across various parity statuses (8) Table 1. Most patients required hospitalization for 4–5 days, reflecting the need for close maternal monitoring, antihypertensive management, and seizure prophylaxis. Longer hospital stays were more frequently observed in patients with comorbidities such as anemia, thrombocytopenia, and HELLP syndrome, (Table 2). These conditions are known to exacerbate maternal morbidity and prolong recovery time, as reported in recent multicenter studies (9).

Table 2. Length of Hospital Stay and Comorbidities in Patients with Severe Preeclampsia (n = 27)

Variable	Category	n	%
Length of Hospital Stay (days)	1–3	4	14.81
	4–5	17	62.96
	6–7	6	22.22
Comorbidities	None	14	51.86
	Anemia	4	14.81
	Thrombocytopenia	2	7.41
	HELLP syndrome	2	7.41
	Gestational diabetes mellitus	1	3.70
	Nephrotic syndrome	1	3.70
	Hyperthyroidism	1	3.70
	Uterine myoma	1	3.70
	Polyhydramnios	1	3.70

Proteinuria findings in this study were predominantly moderate to severe, supporting the diagnosis of severe preeclampsia, (Table 3). Recent guidelines emphasize that although proteinuria is no longer mandatory for diagnosis, its presence reflects significant renal involvement and is associated with increased maternal risk (5,10).

Table 3. Distribution of Proteinuria Levels among Patients with Severe Preeclampsia (n = 27)

Proteinuria Level	n	%
+1	6	22.23
+2	12	44.44
+3	8	29.63
+4	1	3.70

The most clinically relevant finding of this study was the difference in seizure occurrence based on $MgSO_4$ concentration. No seizures were observed among patients receiving $MgSO_4$ 40%, whereas seizures occurred in patients who received $MgSO_4$ 20% (Table 4). This finding supports existing evidence that adequate magnesium exposure is essential to achieve optimal anticonvulsant effects. Several recent studies have demonstrated that subtherapeutic magnesium levels are associated with an increased risk of breakthrough seizures in severe preeclampsia and eclampsia (11,12).

Table 4. Seizure Occurrence Based on Magnesium Sulfate ($MgSO_4$) Concentration (n = 27)

$MgSO_4$ Concentration	Seizure (n)	No Seizure (n)	Total (n)
20%	2	—	—
40%	0	—	—

Pharmacologically, $MgSO_4$ reduces neuronal excitability by antagonizing N-methyl-D-aspartate (NMDA) receptors, decreasing calcium influx into

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neurons, and inducing cerebral vasodilation. These mechanisms collectively contribute to seizure prevention and improved cerebral perfusion (6,12). Higher $MgSO_4$ concentrations may achieve therapeutic serum magnesium levels more rapidly, which is particularly important in severe preeclampsia where the risk of sudden eclamptic seizures is high. Current international guidelines continue to recommend $MgSO_4$ as the first-line agent for seizure prophylaxis in severe preeclampsia, with evidence showing superior efficacy compared to other anticonvulsants and no significant increase in adverse maternal or neonatal outcomes when used appropriately (5,8). The findings of this study reinforce these recommendations and suggest that optimizing $MgSO_4$ concentration may further enhance clinical outcomes. Despite its clinical relevance, this study has limitations, including its descriptive design and relatively small sample size, which preclude causal inference and statistical comparison. Future studies employing analytical or randomized designs with serum magnesium monitoring are warranted to determine the optimal $MgSO_4$ dosing strategy for seizure prophylaxis in severe preeclampsia.

IV. CONCLUSION

This study demonstrates that severe preeclampsia predominantly occurred in women of reproductive age during the third trimester and was frequently accompanied by moderate to severe proteinuria. Magnesium sulfate ($MgSO_4$) remains an effective anticonvulsant for seizure prophylaxis in severe preeclampsia. Patients who received $MgSO_4$ 40% experienced no seizures, whereas seizures were observed in patients receiving $MgSO_4$ 20%, indicating a difference in clinical response based on $MgSO_4$ concentration. These findings suggest that higher $MgSO_4$ concentrations may provide more effective seizure prevention. Further studies with larger sample sizes and analytical designs are recommended to determine the optimal dosing strategy of $MgSO_4$ in severe preeclampsia

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