

The Profile of Serum Potassium Level and Cardiomegaly in Pregnancy with COVID-19 in Prof. Dr. I.G.N.G. Ngoerah General Hospital

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ABSTRACT

Aims and background: Coronavirus disease (COVID-19) is a health crisis that also affects pregnant women. Electrolyte imbalance, especially potassium disorders, are commonly found in pregnancy with COVID-19 and can affect patient outcomes. Additionally, potassium disorders in COVID-19 can worsen cardiac outcomes and patient prognosis. This study was conducted to find out the profile of serum potassium levels and cardiomegaly in pregnancy with COVID-19.

Materials and methods: This descriptive study was used medical record data. All pregnant women with COVID-19 who were hospitalized and had complete data regarding potassium levels and chest X-ray examinations were included in the study. Data were presented in the form of frequency, percentage, mean, and range.

Results: This study included a total of 229 subjects. Most of the subjects' age was 21–35 years (83.3%) and did not have cardiomegaly (86.2%). The mean potassium level in subjects in 1st trimester was 3.20 ± 0.64 , in 2nd trimester was 3.23 ± 0.49 , and in 3rd trimester was 3.67 ± 0.58 . The average serum potassium level in asymptomatic subjects was 3.87 ± 0.68 , while the average serum potassium level in subjects with mild symptoms was 3.59 ± 0.49 , with severe symptoms was 3.51 ± 0.55 , with critical symptoms was 3.31 ± 0.49 , and with moderate symptoms was 3.31 ± 0.45 . The majority of subjects with cardiomegaly experienced severe symptoms (31.6%) followed by mild symptoms (23.7%).

Conclusion: Pregnant women with COVID-19 who had hypopotassemia were mostly in the first trimester, had asthma comorbidity, were critically and moderately symptomatic with COVID-19, used respiratory supports such as nasal cannula and face mask, and also required intensive care. While pregnant women with COVID-19 who had cardiomegaly, mostly were in the third trimester, had comorbidities, severe COVID-19 symptoms, did not use respiratory supports or intensive care, lower mortality rate, and had good neonatal outcomes.

Clinical significance: The COVID-19 in pregnancy with hypopotassemia and cardiomegaly had various adverse outcomes.

Keywords: Cardiomegaly, COVID-19 in pregnancy, Potassium.

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INTRODUCTION

Most nations are grappling with the most significant health emergency in recent history that is the coronavirus disease (COVID-19) resulting from SARS-CoV-2. The population of pregnant women is not spared from COVID-19 infections, with numbers continuously increasing. The vulnerability of pregnant women to COVID-19 is due to hormonal changes and a decrease in lung volume due to increased uterine size during pregnancy, leading to a faster clinical deterioration. Furthermore, various physiological changes such as an expansion in the transverse diameter of the thoracic cavity, reduced tolerance to low oxygen levels, and vasodilation can lead to mucosal swelling and heightened secretion within the upper respiratory tract.¹ Expectant mothers, particularly those in the third trimester, who contract COVID-19 are noted to face heightened risks including premature rupture of membranes, early childbirth, fetal tachycardia, and the potential for vertical transmission from mother to fetus.²

Numerous factors contribute to a negative prognosis in this illness, encompassing demographic characteristics, pre-existing health conditions, and specific laboratory metrics like white blood cell count, D-dimer, C-reactive protein, albumin, lactate dehydrogenase, creatinine, and electrolyte levels. Among these, electrolyte imbalances, notably disruptions in potassium levels,

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are frequently observed in individuals with COVID-19. Based on the analysis of a study, hypopotassemia and hyperpotassemia occurred in 24.3 and 4.15% of COVID-19 patients, respectively. Fluctuations in potassium levels outside the normal range can elevate the risk of adverse outcomes and potentially lead to fatal consequences. Both hypokalemia and hyperkalemia can exacerbate cardiac issues and negatively impact the prognosis of individuals afflicted with COVID-19.³ Research on the profile of serum potassium levels and cardiomegaly in pregnant women with COVID-19 is still very limited;

therefore, further studies are necessary to understand the profile of serum potassium levels, cardiomegaly, disease progression, prognosis, as well as maternal and neonatal outcomes in pregnant women with COVID-19.

MATERIALS AND METHODS

During the period from April 2020 to December 2021, this descriptive study was conducted utilizing medical records of patients. The study focused on pregnant women diagnosed with COVID-19 who were admitted to Prof. Dr. I.G.N.G. Ngoerah Hospital. The sample included those with available data regarding serum potassium levels and chest X-ray examinations.

Subjects were pregnant women in the first, second, or third trimester and had a positive result on RT-PCR for SARS-CoV-2. Potassium levels were determined based on blood results with a normal range of 3.5–4.5 mmol/L. Additionally, cardiomegaly was assessed according to cardiothoracic ratio (CTR) >50% on chest X-ray examination.

Data were presented in frequency, percentage, mean, median, and range. Data analysis was performed using Microsoft Excel and SPSS version 25.

RESULTS

The study encompassed 229 pregnant women diagnosed with COVID-19, as indicated in Table 1. The majority of participants fell within the age range of 21–35 years (83.3%) and did not exhibit cardiomegaly (86.2%).

Regarding the distribution of serum potassium and cardiomegaly, our study results indicated that the mean potassium values in subjects in 1st trimester were 3.20 ± 0.64 , 2nd trimester were 3.23 ± 0.49 , and 3rd trimester were 3.67 ± 0.58 . In terms of the cardiomegaly variable, out of 275 subjects, 237 did not have cardiomegaly, comprising 8 subjects in the 1st trimester (8.4%), 39 in the 2nd trimester (16.5%), and 190 in the 3rd trimester (80.2%).

Regarding the serum potassium and cardiomegaly profile in pregnancy with COVID-19 based on maternal comorbidities (Table 2), the mean serum potassium level in subjects without comorbidities was 3.57 ± 0.57 , subjects with pregnancy-induced hypertension (PIH) 3.97 ± 0.64 , subjects with hypopotassemia 3.17 ± 0.63 , subjects with anemia 3.51 ± 0.39 , subjects with hypoalbuminemia 3.55 ± 0.49 , subjects with thrombocytopenia 3.52 ± 0.63 , subjects with hyponatremia 3.67 ± 0.52 , subjects with transaminitis 4.13 ± 0.89 , subjects with obesity 3.52 ± 0.20 , subjects with asthma 2.93 ± 0.30 , subjects with HIV 4.07 ± 0.37 , and subjects with diabetes mellitus 4.23 ± 0.46 . Most subjects, both with and without comorbidities, did not experience cardiomegaly (50 and 67.5%, respectively). Most subjects with cardiomegaly had comorbidities of PIH and anemia, while most without cardiomegaly had PIH.

Based on the length of hospital stay, the mean length of stay for subjects with hypopotassemia was 8.05 ± 5.68 days, while for subjects without hypopotassemia, it was 4.59 ± 0.59 days. For the cardiomegaly variable, the mean length of stay for subjects with cardiomegaly was 7.61 ± 4.19 days compared with subjects without cardiomegaly, which was 5.33 ± 4.88 days.

In terms of serum potassium and cardiomegaly profile based on the severity of COVID-19 (Table 3), the mean serum potassium level in asymptomatic subjects was 3.87 ± 0.68 , while the mean serum potassium level in subjects with mild symptoms

Table 1: Demographic characteristics of the subjects

Characteristics	N (%)
Age	
≤20 years old	5 (1.8)
21–35 years old	229 (83.3)
>35 years old	41 (14.9)
Cardiomegaly	
Yes	38 (13.8)
No	237 (86.2)
Trimester	
First	8 (2.9)
Second	43 (15.6)
Third	224 (81.5)
Comorbidity	
None	179 (69.38)
Pregnancy-induced hypertension	26 (10.08)
Anemia	20 (7.75)
Hypoalbuminemia	7 (2.71)
Thrombocytopenia	7 (2.71)
Hyponatremia	2 (0.78)
Transaminitis	3 (1.16)
Obesity	4 (1.55)
Asthma	3 (1.16)
HIV	3 (1.16)
Hepatitis B	1 (0.39)
Diabetes mellitus	2 (0.78)
Systemic lupus erythematosus	1 (0.39)
Severity	
Asymptomatic	84 (30.5)
Mild	71 (25.8)
Severe	53 (19.3)
Critical	23 (8.4)
Moderate	44 (16.0)
Respiratory support	
None	164 (59.6)
Nasal cannula	32 (11.6)
High-flow nasal cannula	16 (5.8)
Face mask	10 (3.6)
Non-rebreathing mask	26 (9.5)
Ventilator	27 (9.8)
Intensive care admission	
No	248 (90.2)
Yes	27 (9.8)
Mortality	
Yes	34 (12.4)
No	241 (87.6)
Neonatal outcome	
Vigorous baby	251 (91.3)
Asphyxia	22 (8.0)
Intrauterine fetal death	2 (0.7)

Table 2: Serum potassium levels profile in pregnancy with COVID-19 based on comorbidities

Comorbidities	Potassium level (mmol/L)	Cardiomegaly	
		Yes	No
None	3.57 ± 0.57	19 (50.0%)	160 (67.5%)
Pregnancy-induced hypertension	3.97 ± 0.64	8 (21.1%)	18 (7.6%)
Anemia	3.51 ± 0.39	2 (5.3%)	18 (7.6%)
Hypoalbuminemia	3.55 ± 0.49	1 (2.6%)	6 (2.5%)
Thrombocytopenia	3.52 ± 0.63	1 (2.6%)	6 (2.5%)
Hyponatremia	3.67 ± 0.52	1 (2.6%)	1 (0.4%)
Transaminitis	4.13 ± 0.89	0 (0%)	3 (1.3%)
Obesity	3.52 ± 0.20	1 (2.6%)	3 (1.3%)
Asthma	2.93 ± 0.30	0 (0.0%)	3 (1.3%)
HIV	4.07 ± 0.37	0 (0.0%)	3 (1.3%)
Diabetes mellitus	4.23 ± 0.46	0 (0.0%)	2 (0.8%)

Table 3: Serum potassium and cardiomegaly profile in pregnancy with COVID-19

Outcomes	Potassium level (mmol/L)	Cardiomegaly	
		Yes	No
Severity			
Asymptomatic	3.87 ± 0.68	6 (15.8%)	78 (32.9%)
Mild	3.59 ± 0.49	9 (23.7%)	62 (26.2%)
Severe	3.51 ± 0.55	12 (31.6%)	41 (17.3%)
Critical	3.31 ± 0.49	6 (15.8%)	17 (7.2%)
Moderate	3.31 ± 0.45	5 (13.2%)	39 (16.5%)
Respiratory support			
None	3.74 ± 0.62	18 (47.4%)	146 (61.6%)
Nasal cannula	3.36 ± 0.43	3 (7.9%)	29 (12.2%)
High-flow nasal cannula	3.41 ± 0.60	0 (0.0%)	16 (6.8%)
Face mask	3.19 ± 0.40	3 (7.9%)	7 (3.0%)
Non-rebreathing mask	3.39 ± 0.52	6 (15.8%)	20 (8.4%)
Ventilator	3.37 ± 0.43	8 (21.1%)	19 (8.0%)
Intensive care admission			
No	3.61 ± 0.61	30 (78.9%)	218 (92.0%)
Yes	3.39 ± 0.42	8 (21.1%)	19 (8.0%)
Mortality			
Yes	3.41 ± 0.41	9 (23.7%)	25 (10.5%)
No	3.62 ± 0.61	29 (76.3%)	212 (89.5%)
Neonatal outcome			
Vigorous baby	3.58 ± 0.59	33 (86.8%)	218 (92.0%)
Asphyxia	3.64 ± 0.65	4 (10.5%)	18 (7.6%)
Intrauterine fetal death	3.94 ± 0.91	1 (2.6%)	1 (0.4%)

was 3.59 ± 0.49 , with severe symptoms was 3.51 ± 0.55 , with critical symptoms was 3.31 ± 0.49 , and with moderate symptoms was 3.31 ± 0.45 . Regarding cardiomegaly, most subjects with cardiomegaly experienced severe symptoms (31.6%), followed by mild symptoms (23.7%).

In terms of the use of respiratory supports, the mean serum potassium level in subjects without the use of respiratory support was 3.74 ± 0.62 , while the mean serum potassium level in subjects using nasal cannula was 3.36 ± 0.43 , high-flow nasal cannula (HFNC) was 3.41 ± 0.60 , face mask was 3.19 ± 0.40 , non-rebreather mask (NRM) was 3.39 ± 0.52 , and ventilator was 3.37 ± 0.43 . Regarding cardiomegaly, most subjects without cardiomegaly did not use any respiratory support (61.6%).

In terms of maternal mortality, the mean serum potassium level in subjects who survived during treatment was 3.41 ± 0.41 , while in subjects who did not survive during treatment, the mean serum potassium level was 3.62 ± 0.61 . In mortality based on cardiomegaly, the majority of subjects, both with and without cardiomegaly in this study, survived until the end of the study (76.3 and 89.5%, respectively).

Regarding neonatal outcomes, the mean serum potassium level in subjects with vigorous baby outcomes was 3.58 ± 0.59 , while in subjects with neonatal asphyxia outcomes, it was 3.64 ± 0.65 , and in subjects with intrauterine fetal demise (IUID) outcomes, it was 3.94 ± 0.91 . Regarding cardiomegaly, the majority of subjects, both with and without cardiomegaly in this study, had vigorous baby neonatal outcomes (86.8 and 92.0%, respectively).

DISCUSSION

Based on the distribution according to age, most subjects were in the age-group of 21–35 years with 229 subjects (83.3%), while the age-group of 20 years or younger had the fewest subjects, with only 5 (1.8%). Similar research in Surakarta showed that out of 62 confirmed pregnant women with COVID-19, the majority (90.3%) were in the age-group of 20–35 years.² Most subjects in this study did not experience cardiomegaly (86.2%). Cardiovascular complications play a critical role in the prognosis and survival of individuals with COVID-19. According to research conducted by Guo et al., among 187 COVID-19 patients studied, 27.8% suffered from myocardial injury.³ The exact mechanisms through which SARS-CoV-2 induces myocardial injury are not completely elucidated. However, research focusing on the role of ACE-2 receptors in the virus's life cycle and the consequences of ACE-2 disruption suggest potential pathways. The interaction between ACE-2 and the SARS virus is believed to trigger inflammation and myocardial injury. Additionally, reduced ACE-2 regulation hinders the protective effects of angiotensin, leading to increased production of tumor necrosis factor alpha (TNF α), which can contribute to cardiac damage. Excessive cytokine response is also considered a potential mediator of damage to heart muscle cells.³

Based on serum potassium and cardiomegaly, our study results showed that the mean potassium values in subjects in 1st trimester were 3.20 ± 0.64 , 2nd trimester were 3.23 ± 0.49 , and 3rd trimester were 3.67 ± 0.58 . A study using simple logistic regression analysis indicated an increased likelihood of COVID-19 with decreasing potassium levels before childbirth. For every one-unit decrease in serum potassium levels among pregnant women before delivery, the odds of symptomatic infection increased by 19.72.⁴

In the profile of serum potassium and cardiomegaly in pregnancy with COVID-19 based on maternal comorbidities, the mean serum potassium level in subjects without comorbidities was 3.57 ± 0.57 , subjects with PIH is that hypokalemia in their study was linked to underlying conditions. Specifically, 81% of patients with severe hypokalemia and 45% of those with mild

hypokalemia had pre-existing conditions like diabetes and hypertension, in contrast to only 12% of patients with normal potassium levels.⁵

Most subjects, both with or without comorbidities, did not experience cardiomegaly (50 and 67.5% respectively). The majority of subjects who experienced cardiomegaly had comorbidities such as PIH and anemia, while the majority of subjects who did not experience cardiomegaly had PIH. Hypertensive disorders during pregnancy, such as pre-eclampsia and eclampsia, are noted as cardiovascular events associated with COVID-19 cases in pregnant individuals. According to Wu et al., among 29 pregnant COVID-19 cases studied, two of them (6.90%) developed hypertensive disorders.^{6,7}

In the profile of serum potassium and cardiomegaly based on the severity of COVID-19, the mean serum potassium level in asymptomatic subjects was 3.87 ± 0.68 , while in subjects with mild symptoms it was 3.59 ± 0.49 , with severe symptoms it was 3.51 ± 0.55 , with critical symptoms it was 3.31 ± 0.49 , and with moderate symptoms it was 3.31 ± 0.45 . Tanacan et al. reported that in the moderate/severe COVID-19 group, there were significantly higher levels of high serum sodium (hypernatremia), potassium replacement, hypokalemia, hyperchloremia, initial serum magnesium (hypermagnesemia), and hypokalemia. They also found a weak but statistically significant positive correlation between hypernatremia, hypokalemia, hyperchloremia, hypermagnesemia, hypocalcemia, and the severity of COVID-19. Other studies have similarly noted that symptomatic women had notably lower potassium levels compared with asymptomatic women.⁸

Based on the use of respiratory support, the mean serum potassium level in subjects not using respiratory support was 3.74 ± 0.62 , while the mean serum potassium level in subjects using nasal cannula was 3.36 ± 0.43 , HFNC was 3.41 ± 0.60 , face mask was 3.19 ± 0.40 , NRM (non-rebreather mask) was 3.39 ± 0.52 , and ventilator was 3.37 ± 0.43 . Moreno-P et al.'s study on hypokalemia as a sensitive biomarker for disease severity and the need for invasive mechanical ventilation in COVID-19 patients suggests that individuals with low potassium levels who contract SARS-CoV-2 are more likely to require invasive mechanical ventilation.⁹

The mean serum potassium level in subjects requiring intensive care was 3.39 ± 0.42 , while the mean in subjects not requiring intensive care was 3.61 ± 0.61 . Tanacan et al. found a weak but statistically significant positive correlation between hypopotassemia and obstetric complications. Another study by Szoke et al. mentioned that the median potassium upon hospital admission was significantly lower, and hypopotassemia occurred more frequently in COVID-19 patients compared with controls.^{8,10}

Based on maternal mortality, the mean serum potassium level in subjects who survived during treatment was 3.41 ± 0.41 , while in subjects who did not survive during treatment, the mean serum potassium level was 3.62 ± 0.61 . Regarding mortality based on cardiomegaly, most subjects, both with and without cardiomegaly in this study, survived until the end of the study (76.3 and 89.5%, respectively). Previous studies conducted by Palaka et al. and Petnak et al. have shown that generally, both hypopotassemia and hyperpotassemia are associated with poor prognosis. Few studies had revealed a U-shaped correlation between this serum potassium levels and adverse outcomes.^{11,12}

This study was limited to a tertiary hospital in which the data may not be generalized into a population, further research in this field is needed especially at the level of multicenter hospital.

CONCLUSION

Pregnant women with COVID-19 who had hypopotassemia have the following characteristics: In the first trimester, had asthma comorbidity, were critically and moderately symptomatic with COVID-19, used respiratory supports such as nasal cannula and face mask, and also required intensive care. While pregnant women with COVID-19 who had cardiomegaly, mostly were in the third trimester, had comorbidities, severe COVID-19 symptoms, did not use respiratory supports or intensive care, lower mortality rate, and had good neonatal outcomes.

Clinical Significance


The COVID-19 in pregnancy complicated by hypopotassemia and cardiomegaly had various adverse outcomes.

AUTHORS CONTRIBUTIONS

All authors fully contributed to this research.

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