

SENSITIVITY EVALUATION OF BLOOD LACTATE LEVELS AND OXYGEN SATURATION AS BIOMARKERS OF OCCULT TISSUE HYPOXIA IN MYOCARDIAL INFARCTION PATIENTS IN THE INTENSIVE CARE ROOM

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ABSTRACT

Acute Myocardial Infarction (AMI) is emergency cardiovascular contributing factors to about 32% of deaths globally (17.8–19.8 million people per year). At Dr. Wahidin Sudiro Regional Hospital Husodo, Mojokerto City, recorded as many as 95 cases of AMI (STEMI and NSTEMI) in 2024 and increasing up to 114 cases in a 3- month period last in 2026. AMI conditions can cause disturbance perfusion network until Occult tissue hypoxia occurs . However , saturation normal oxygen yet Of course reflect adequacy oxygenation network so that required inspection level lactate blood as indicator additional . Purpose study This is analyze saturation oxygen and levels lactate blood as Predictors of Occult Tissue Hypoxia in Acute Myocardial Infarction Patients in the Intensive Care Unit of Dr. Wahidin Sudiro Regional Hospital Husodo, Mojokerto City. Research This use design observational analytic with cross-sectional approach . Population study as many as 72 patients with consecutive sampling technique , so that obtained sample A total of 52 respondents were dominated by type sex men (69.2%) and groups aged 50–69 years (78.8%). Variable study covering saturation oxygen and levels lactate blood . Data collected use pulse oximetry examination of saturation oxygen , and Blood Gas Analysis (BGA) examination as level lactate blood . Research results show all over respondents own saturation normal oxygen (100%), whereas part big level lactate is in the category hyperlactatemia light as many as 19 respondents (36.5%). The results of the analysis test obtained p- value = 0.000 with coefficient correlation $r = -0.945$, so there is very strong and negative relationship between saturation oxygen and levels lactate blood . The results show that inspection level lactate blood can used as more indicators sensitive For detect occult tissue hypoxia early in AMI patients in the intensive care unit intensive .

Keywords: *Saturation Oxygen , Lactate Levels , Acute Myocardial Infarction*

INTRODUCTION

Heart disease is the leading cause of death worldwide and in Indonesia. Acute Myocardial Infarction (AMI) is a cardiovascular emergency characterized by necrosis of the heart muscle resulting from an imbalance between oxygen supply and demand (Liu et al., 2026). Extensive myocardial damage in patients with Acute Myocardial Infarction often triggers systemic hemodynamic disturbances that result in decreased tissue perfusion. One form of decreased tissue perfusion is abnormal oxygen saturation (<95%) (Severino et al., 2021) .

Oxygen saturation levels reflect the oxygen supply in the blood to meet the needs of the body's organs. However, under certain conditions, patients with Acute Myocardial Infarction may exhibit oxygen saturation levels that appear normal (normoxia), despite a failure in oxygen distribution at the cellular level. This condition triggers cells to increase anaerobic metabolism in the form of increased lactic acid production in the blood (>2.0 mmol/L). In patients with AMI, blood lactate levels are the result of anaerobic metabolism that is formed due to a lack of adequate oxygen supply to the heart tissue. Therefore, an

imbalance between oxygen supply and increased blood lactate levels in the myocardium of patients with Acute Myocardial Infarction (AMI) can risk triggering irreversible cardiogenic shock (Meier et al., 2013) .

Based on information from *The World Health Organization* (2019) , shows that cardiovascular disease, including *Acute Myocardial Infarction* (AMI), is the leading cause of death in the world, killing around 17.8 to 19.8 million people per year or 32% of all global deaths in 2022. *The World Health Organization* (2019) , stated that more than 75% of deaths occur in low-middle income countries and are often due to preventable risk factors. Based on findings in the *Annals of Translational Medicine journal* by Yu et al. (2020) , an oxygen saturation value of 95% is the midpoint of the optimal oxygen saturation range (94-96%) which is independently associated with reduced in-hospital mortality and increased survival in *Acute Myocardial Infarction* (AMI) patients (Zhang et al., 2024) . In a journal research study by Vermeulen et al. (2010) , it was found that approximately 31.3% to 34% of STEMI patients at first admission had increased lactate levels (≥ 1.2 to ≥ 1.8 mmol/L) even though many of them did not show clinical signs of shock or obvious systemic hypoxia on initial examination. This is confirmed by the journal presented by Gjesdal et al. (2018) , who noted that in *Acute Myocardial Infarction patients* with heart failure without overt cardiogenic shock, approximately 28% of patients with lactate (≥ 2.5 mmol/L) experienced short-term death, proving that lactate is a much more sensitive indicator of tissue hypoxia than peripheral oxygen saturation (SpO₂) monitoring alone in detecting the threat of hidden cell death.

Meanwhile, according to the results of the 2018 Basic Health Research (Riskesdas) data in Indonesia, *Acute Myocardial Infarction* (AMI) is the highest cause of death with an intrahospital mortality rate reaching 8.9% - 9.6% based on studies in 2018-2023. Based on research data and health reports in the Mojokerto area, the prevalence of *Acute Myocardial Infarction* (AMI) or acute myocardial infarction shows a quite significant number. Based on case research at Dr. Wahidin Sudiro Husada Mojokerto Regional Hospital in 2024, a study conducted in January-December recorded that there were 95 acute myocardial infarction patients being treated .

Based on research introduction carried out in the ICU room of Dr. Wahidin Sudiro Regional Hospital Husodo, Mojokerto City, on March 29 , 2026 , in 5 Acute Myocardial Infarction (AMI) patients , it was found phenomenon clinically significant in which the majority patients (80%) showed condition normoxia with mark saturation oxygen (SpO₂) ranges from 95% to 99%, however in a way simultaneously own level lactate blood pressure above normal threshold (> 2.0 mmol/L), Among them Mr.S SpO₂ 98% with lactate 3.2mmol/L, Mr.F SpO₂ 96% with lactate 2.8mmol/L, Mr.M SpO₂ 97% with lactate 2.5mmol/L, Ny.I SpO₂ 95% with lactate 4.1mmol/L, Mrs. J SpO₂ 96% with lactate 2.8mmol/L. Phenomenon This prove existence Occult Tissue Hypoxia (OTH) event or hypoxia network hidden , where the cells myocardium Actually has experience failure metabolism mobile although mark oxygenation macro looks stable .

In patients with Acute Myocardial Infarction (AMI), a sudden blockage of the coronary arteries cuts off blood supply to the heart muscle. This condition systemically reduces tissue perfusion, where blood flow is no longer able to meet the body's metabolic needs. As a result, occult tissue hypoxia occurs. Although blood oxygen saturation tests may still show normal values (normoxia), cells at the micro level are actually deprived of oxygen.

This failure of oxygen supply forces cells to switch from normal respiration to anaerobic metabolism to maintain cellular survival (Vermeulen et al., 2010) .

This switch to anaerobic metabolism triggers a surge in lactate levels in the blood circulation as a byproduct of imperfect glycolysis. When lactate levels increase significantly, especially reaching a threshold of more than (> 2 mmol / L), this is a strong indicator of energy deficit and ongoing cell damage. Clinically, high lactate levels are directly correlated with the extent of the infarction or area of heart muscle damage. The higher the lactate concentration detected when the patient is admitted to the hospital, the larger the area of necrosis (tissue death) in the heart, which automatically increases the risk of severe complications and death in Acute Myocardial Infarction (AMI) patients (Gajewski et al. (2025) . Based on the research journal Bakker et al. (2013) , emphasized that although oxygenation interventions successfully increase SpO₂ to 100%, it does not automatically correct *Occult Tissue Hypoxia* , so that lactate levels that remain high even though the patient has been given oxygen indicate microcirculatory failure that cannot be resolved only with oxygen supplementation.

Based on this study, the researchers emphasized that this situation reveals a research gap and fundamental clinical limitations in current intensive care practice. *Pulse oximetry monitoring* remains the primary instrument used to evaluate the oxygenation status of patients with AMI . existing phenomena that Pulse ox ymetry only describes the availability of oxygen in the peripheral circulation or macro. On the other hand, blood lactate level examinations have not been carried out routinely and simultaneously at Dr. Wahidin Regional Hospital for Hemodynamic monitoring . In fact , facts in the field show that AMI patients are already at risk of *Occult Tissue Hypoxia* . Blood lactate level examination has proven to be much more sensitive . This proven existence improvement lactate >2.00 mmol/L and compared to *pulse oximetry* in detecting *Occult Tissue Hypoxia* , because lactate directly reflects the shift in cellular metabolism from aerobic to anaerobic due to oxygen starvation at the microcirculation level of myocardial tissue.

Therefore that , researcher emphasize that step strategic For overcome limitations detection hypoxia network in AMI patients is with integrate inspection level lactate blood in a way simultaneous through inspection *Blood Gas Analysis* (BGA) as the gold standard for detecting *Occult Tissue Hypoxia* in patients *Acute Myocardial Infarction* . So power health can get mark saturation oxygen precision arteries at a time measure level lactate as bioindicators failure hemodynamics mobile . Research This give contribution innovative in care nursing critical through transformation paradigm monitoring from the beginning only based on macrohemodynamic parameters standard (*pulse oximetry*), going to metabolic status monitoring precision mobile with level lactate blood use detect *Occult Tissue Hypoxia* in a way early and prevent worsening condition AMI patients in the room intensive .

METHOD

This study uses an analytical observational research design with a cross-sectional approach which aims to analyze the relationship between oxygen saturation (SpO₂) as an independent variable with blood lactate levels as a dependent variable as a predictor . *occult tissue hypoxia* in acute patients Myocardial Infarction (AMI). A *cross-sectional approach* was chosen because the measurement of both variables was carried out simultaneously at one

time when the patient was undergoing treatment in the Intensive Care Unit. Care Unit (ICU), so that the relationship between oxygen saturation and blood lactate levels can be analyzed simultaneously.

The study population was all patients with a diagnosis of Acute Myocardial Infarction (AMI) who underwent treatment in the Intensive Care Unit Care Unit (ICU) and Intensive Care Unit Cardiac The Care Unit (ICCU) of Dr. Wahidin Sudiro Husodo Regional General Hospital, Mojokerto City, had 72 patients. The research sample consisted of 52 respondents selected using non- probability techniques. Consecutive sampling, in which all patients who meet the inclusion criteria are taken sequentially until the required sample size is met. The inclusion criteria for the study included patients diagnosed with AMI who had normoxic oxygen saturation values (SpO₂ 95–100%) and were willing to participate in the study. Patients who did not meet the research criteria or had conditions that could affect the measurement results were excluded from the study.

Data collection was conducted at Dr. Wahidin Sudiro Husodo Regional General Hospital in Mojokerto City after researchers obtained ethical approval and research permits. Oxygen saturation was measured using a Pulse Oximeter. Oximetry , while blood lactate levels were obtained through Blood Gas Analysis (BGA) using arterial blood samples processed by the hospital laboratory. Prior to data collection, all respondents were given an explanation of the study's purpose and asked to sign an informed consent form. Consent is a form of agreement to be a respondent. The data obtained then went through editing , coding , scoring , and tabulation before being analyzed using SPSS. Univariate analysis was used to describe the characteristics of respondents and the distribution of each research variable, while bivariate analysis was conducted using the Spearman's correlation test . rho with a significance level (α) of 0.05 to determine the relationship between oxygen saturation and blood lactate levels as predictors *occult tissue hypoxia in* acute patients Myocardial Infarction. This study has received ethical approval, as evidenced by the ethical clearance letter with No. 115/KEP/UBS-PPNI/VI/2026.

FINDING AND DISCUSSION

RESEARCH RESULT

Table 1Frequency Distribution of Respondent Characteristics Based on Gender in Intensive Care Units Care Unit of Dr. Wahidin Sudiro Husodo Regional General Hospital, Mojokerto

No	Respondent Characteristics	Frequency (F)	Percentage (%)
1	Gender		
	Man	36	69.2
	Woman	16	30.8
2	Age		
	30-49 Years	8	15.4
	50-69 Years	41	78.8
	70-89 Years	3	5.8
	Total	52	100

Source : primary data 2026

Table 1 shows from 52 respondents part big have type sex man as many as 36 respondents (69.2%) and some big respondents aged 50-69 years as many as 41 respondents (78.8%).

Table 2 Oxygen Saturation Levels in Acute Patients Myocardial Infarction in the Intensive Care Unit at Dr. Wahidin Sudiro Husodo Regional Hospital

Respondents	Oxygen Saturation Level (SPO2)
Mean	96.88
Median	97.00
Mode	95

Source : primary data 2026

Table 2 shows that Of the 52 respondents , the mean value was 96.88, the value The median is 97.00 , and the most frequent value appear is 95.

Table 3 Blood Lactate Levels in Acute Patients Myocardial Infarction in the Intensive Care Unit at Dr. Wahidin Sudiro Husodo Regional Hospital

Respondents	Blood Lactate Levels
Mean	2,712
Median	2,500
Mode	2.1

Source : primary data 2026

Table 3 shows that Of the 52 respondents , the mean value was 2.712, the value The median is 2,500 , and the most frequent value appear is 2.1.

Table 4 Analysis of Oxygen Saturation and Blood Lactate Levels as Predictors of Occult Tissue Hypoxia in Acute Myocardial Infarction Patients in the Intensive Care Unit of Dr. Wahidin Sudiro Husodo Hospital, Mojokerto City

No.		Oxygen Saturation Level (SPO2)	Blood Lactate Levels
95% Confidence Interval for Mean	Lower Bound	96.50	2,451
	Upper Bound	97.27	2,972
Standard Deviation		1,395	.9349
Minimum		95	1.1
Maximum		99	4.5
p-value	0.000		
C	-0.945		

Source : primary data, 2026

Based on Table 4 regarding Analysis of Acute Myocardial Infarction (AMI) patients in the ICU of Dr. Wahidin Sudiro Regional Hospital Husodo Mojokerto City, average

saturation value oxygen (spO₂) is in the 95% Confidence Interval (CI) range between 96.50% (Lower Bound) to 97.27% (Upper Bound), with standard deviation amounting to 1,395 and range mark from 95% to 99%. Meanwhile that , the level lactate blood patient own the mean value in the 95% CI range between 2.451 mmol/L (Lower Bound) to 2.972 mmol/L (Upper Bound), with standard deviation of 0.9349, and variation mark lowest of 1.1 mmol/L and the highest reached 4.5 mmol/L.

Analysis test results tabulation cross between second variables the show p-value of 0.000 ($p < 0.05$), which proves existence significant relationship in a way statistics between saturation oxygen (spO₂) and blood levels lactate blood . Besides that , the acquisition mark coefficient correlation (r) of -0.945 (approaching -1) indicates level very strong relationship with direction negative (opposite), which indicates that the more low mark saturation oxygen to the patient , then will the more tall level lactate in his blood as form response metabolism anaerob consequence hypoxia network .

Research result show from analysis between level saturation oxygen with level lactate . Respondents who have level saturation normal oxygen with level normal lactate levels as many as 12 respondents (23.1%). Respondents who have level saturation normal oxygen with level lactate hyperlactatemia light as many as 19 respondents (36.5%). Respondents who have level saturation normal oxygen with level lactate hyperlactatemia currently as many as 16 respondents (30.8%). Respondents who have level saturation normal oxygen with level lactate hyperlactatemia heavy as many as 5 respondents (9.6%).

Findings empirical This in a way real show that part big AMI patients (76.9%) tend to experience Occult Tissue Hypoxia (OTH) event , namely condition hypoxia network hidden behind appearance saturation oxygen normal - appearing peripherals . Phenomenon This prove that inspection level lactate blood Far more sensitive compared to internal SpO₂ (pulse oximetry) monitoring detect existence failure perfusion and shift metabolism mobile to direction anaerob in a way early . Coefficient value correlation (r) of -0.945 indicates that there is a very strong and lasting relationship negative between level saturation oxygen with level lactate blood .

DISCUSSION

Saturation Level Identification Oxygen in Acute Myocardial Infarction Patients in the Intensive Care Unit at Dr. Wahidin Sudiro Regional Hospital Husodo

Research result show that of 52 respondents , all respondents have level saturation normal oxygen levels in 52 respondents (100%). Based on general data characteristics respondents in Table 4.1, percentage impact highest found in the type sex man that is as many as 36 respondents (69.2%) and dominated by the group age middle age to elderly early (50–69 years) , namely as many as 41 respondents (78.8%). This result indicates that oxygenation status patient during undergo treatment in the ICU is in condition adequate , namely is in the normal range ($\geq 95\%$), so that need oxygen networks , in particular myocardium , can fulfilled with Good .

According to Yue Yu (2022), Acute Myocardial Infarction (AMI) occurs consequence existence blockage in the arteries coronary which is generally caused by rupture plaque atherosclerosis followed by formation thrombus . In the group man own risk more tall consequence No existence effect protective estrogen hormone , which is exacerbated by factors style live . Meanwhile that , the increase age (50–69 years) correlated with

degenerative processes vessels blood , calcification , and decreased elasticity arteries coronary . Blockage This result in flow blood to network myocardium hampered so that supply oxygen and nutrients become reduced . Condition the cause imbalance between needs and availability oxygen to the muscles heart , which ultimately cause ischemia until necrosis network if No quick handled . The situation hypoxia network that occurs in AMI can make things worse damage myocardium Because cells muscle the heart is very dependent on the blood supply adequate oxygen For maintain function contractile . When the supply oxygen decreased metabolism cell changed from aerobic become anaerobic producing sour lactate , so that cause decrease in cellular pH and accelerate damage network . If the condition This lasts a long time, then will happen death cell myocardial in nature permanent and can lower function heart in a way overall .

According to Koejima (2022) monitoring saturation oxygen (SpO₂) is one of the indicator important in management AMI patients , especially in intensive care intensive . Saturation oxygen reflect percentage of bound hemoglobin with oxygen in blood , so that can give description about adequacy oxygenation network in a way No directly . Through continuous monitoring use tool such as pulse oximetry, energy health can detect in a way early existence decline oxygenation (hypoxemia) and immediately do necessary interventions , such as giving therapy oxygen or support ventilation .

According to opinion researchers , results research that shows all over respondents own saturation normal oxygen describes that the implementation AMI patients in the ICU have walk optimally , especially in aspect monitoring and management oxygenation . Condition This possibility influenced by accuracy in giving therapy oxygen which is selective , monitoring strict use adequate tools , as well as response fast power health to change condition patients . Besides that's it , it's stable saturation oxygen throughout respondents also indicated that need oxygen network can fulfilled with Good so that risk occurrence hypoxia that can make things worse damage myocardium can minimized . Although all over patient own saturation oxygen in normal limits , things This No can made into the only one indicator success therapy in a way as a whole . So that evaluation condition patient still must done in a way comprehensive with considering other parameters such as condition hemodynamics , function heart , and results inspection support . Monitoring saturation oxygen still become part important in maintenance AMI patients , however must integrated with evaluation clinical in a way comprehensive For get results optimal care .

Identification of Blood Lactate Levels in Acute Myocardial Infarction Patients in the Intensive Care Unit at Dr. Wahidin Sudiro Regional General Hospital Husodo

Research result show that of 52 respondents , the level lactate Blood count in Acute Myocardial Infarction (AMI) patients in the Intensive Care Unit (ICU) of Dr. Wahidin Sudiro Regional Hospital Husodo Mojokerto shows that part big respondents experience hyperlactatemia light (36.5%) and some small experience hyperlactatemia weight (9.6%). Obtained results that the most numerous group affected by the phenomenon improvement lactate This is men (69.2%) and aged 50–69 years (78.8%). This indicates that in AMI patients still there is disturbance perfusion network with varying degrees , although has get maintenance optimal intensive conditions This common occurs in patients critical Because existence imbalance between supply and demand oxygen tissue , especially in the myocardium that is experiencing ischemia .

According to Zhu (2022) the increase level lactate is response to condition hypoxia network consequence decline perfusion . In AMI, the blockage arteries coronary cause decrease flow blood to muscle heart so that cell experience lack oxygen . Increase level lactate in AMI patients is related close with improvement mortality in a way significant . Factor age >50 years slow down the elimination process lactate clearance by the liver and kidneys consequence decline organ function in general natural , so that accumulation lactate in blood become more real and persistent (hyperlactatemia) light until weight) compared patient age young . This is trigger change metabolism from aerobic become anaerobic producing sour lactate as product end . Accumulation lactate in blood Then become indicator important existence hypoperfusion network . The study by Zhu et al. (2022) in BMC Cardiovascular Disorders journal confirms that level increased lactate relate close with degrees severity ischemia and disorders perfusion in AMI patients .

According to Wang et al. (2023) improvement level lactate , including its derived parameters such as lactate-to-albumin ratio, has connection significant with improvement risk mortality in AMI patients in the ICU. In general demographics , conditions This often found in patients age >45 years and gender sex man , remembering group the own prevalence disease heart more coronary high . This is show that lactate No only functioning as indicator hypoxia network , but also as clinical prognosis predictors patient .

According to opinion researchers , dominant hyperlactatemia light on research This show that the procedure AMI patients in the ICU are already walk Enough effective in maintain perfusion network and prevent occurrence hypoxia heavy . However existence patient with hyperlactatemia heavy although only (9.6%) remains become attention important Because related with a better prognosis bad . Required more monitoring strict , evaluation comprehensive , as well as fast and appropriate intervention so that conditions patient can quick stabilized . Measurement level lactate No only functioning as a diagnostic parameter , but also as tool evaluation therapy and predictors external clinical in AMI patients .

Analysis of Oxygen Saturation and Blood Lactate Levels as Predictors of Occult Tissue Hypoxia in Acute Myocardial Infarction Patients in the Intensive Care Unit of Dr. Wahidin Sudiro Husodo Hospital, Mojokerto City

Respondents who have level saturation normal oxygen with level normal lactate levels in 12 respondents (23.1%). According to Tamura (2024), the condition oxygenation adequate body enable metabolic processes cell ongoing in a way aerobic . Under these conditions this , cell No experience lack oxygen so that No happen improvement production sour lactate which is generally produced through metabolism anaerobic . Balance between supply oxygen and needs network still awake , so that level lactate in blood is at in normal limits .

Respondents who have level saturation normal oxygen with level lactate hyperlactatemia light as many as 19 respondents (36.5%). Conditions This show that although saturation oxygen is at in normal limits , increase level lactate still can occurs . According to Abdelaziz (2023) the level of lactate No only influenced by oxygenation , but also by other factors such as improvement activity metabolism , stress physiological disorders perfusion tissue , as well as inflammatory processes . In addition that is , hyperlactatemia light can happen consequence imbalance between production and cleaning lactate in body , even though supply oxygen Still adequate . This is signify that mark

saturation normal oxygen yet Of course reflect condition perfusion network in a way as a whole , so that still allows occurrence improvement level lactate in limit light .

Respondents who have level saturation normal oxygen with level lactate hyperlactatemia currently as many as 16 respondents (30.8%). Conditions This show that although saturation oxygen is at in normal limits , increase level lactate still can happened . This is caused by Because saturation oxygen No fully reflect perfusion network in a way microcirculation . According to Chen (2023), saturation oxygen network relate with the cleaning process lactate , so that disturbance perfusion can cause improvement level lactate although oxygen looks normal.

Respondents who have level saturation normal oxygen with level lactate hyperlactatemia heavy as many as 5 respondents (9.6%). Condition This show that although saturation oxygen is at in normal limits , increase level lactate until category heavy still can happened . This is indicates that saturation oxygen No always reflect adequacy perfusion and oxygenation at the level network (microcirculation).

According to Park (2022) in AMI conditions , blockage arteries coronary heart disease that causes decline supply oxygen to network myocardial . In patients men and elderly with range age >50 years can happen Because hemoglobin affinity for oxygen and ability transport microcirculation capillary has experience decline quality consequence stress oxidative and response inflammation systemic vessels blood . Imbalance between supply and demand oxygen This trigger change metabolism cell from aerobic become anaerobic , which produces sour lactate as product end . Accumulation lactate in blood become indicator existence hypoxia network and interference perfusion , so that level lactate often used as an important biomarker in patients critical .

According to Cao (2022) lactate clearance disorders are related with condition hypoperfusion better network and clinical outcomes bad for the patient critical . Decline cleaning lactate (lactate clearance) experience occurs in the range age middle aged over 45-50 years and more often experienced by men . This is due to capacity glycolytic muscle in a way physiological , men own percentage mass muscles and profile enzyme more glycolytic tall so that produce lactate more many . However , as time goes by increase age , capacity disposal lactate (clearance) no as fast as possible production . This is show that No only mark lactate beginning , but also dynamics change lactate during maintenance own mark important clinical analysis . between level saturation oxygen and levels lactate show that saturation oxygen No always capable describe condition oxygenation network in a way comprehensive . Lactate become indicator more additions sensitive in detect occult tissue hypoxia, so that use both parameters in together is very important in practice clinical , especially in AMI patients in the ICU.

According to Tan (2023), disturbances perfusion network can cause decline lactate clearance so that level lactate still tall although oxygenation looks adequate . Besides that , Kleem (2024) explains that hyperlactatemia heavy can triggered by conditions stress metabolic disorders circulation , as well as response inflammation systemic , so that improvement lactate No only influenced by the level of saturation oxygen solely .

According to opinion researchers , some big patient own saturation oxygen in normal limits , however improvement level lactate still can happen consequence disturbance perfusion network specifically for group prone to like man age middle- aged -elderly . This is show that monitoring level lactate Far more sensitive in detect OTH automatically routine

as part from evaluation condition patient . With existence combination between monitoring saturation oxygen and levels lactate , energy health can do detection early to hypoxia network hidden as well as give more interventions fast and precise . Besides that , approach this can also help in increase quality service as well as lower risk complications and mortality in AMI patients in the intensive care unit maintenance intensive .

So obtained results analysis between SpO_2 and blood pressure lactate blood with mark average SpO_2 was in the range of 95% CI 96.50–97.27%, with minimum value of 95% and maximum of 99%, while level lactate blood has a 95% CI of 2.451–2.972 mmol/L, with minimum value of 1.1 mmol/L and maximum of 4.5 mmol/L. This result show that the more low level saturation oxygen , then level lactate blood tend the more increased . Condition the indicates occurrence hypoxia network (*occult tissue hypoxia*) although part big patient Still own mark SpO_2 which is in normal limits . Findings This in line with study Hidayat et al . (2023) who stated that improvement level lactate is indicator sensitive existence disturbance perfusion network in patients critical , even when oxygenation parameters like saturation oxygen Still looks normal.

In a way theory , in AMI patients it occurs decline perfusion consequence decrease flow blood coronary so that supply oxygen to network become No adequate . When oxygen is available No capable fulfil need metabolism cells , body will switch from metabolism aerobic become metabolism anaerobic producing accumulation sour lactate . Saturation measured oxygen via pulse oximetry only describe percentage of bound hemoglobin oxygen in blood arteries , but No reflect effectiveness delivery oxygen to level network . Therefore that , patient can own mark SpO_2 is normal but still experience hypoxia network consequence disturbance perfusion microcirculation . This is supported by Prasetyo and Nugroho (2022) who explain that level lactate blood is a more accurate biomarker sensitive in detect hypoperfusion network compared to saturation oxygen , especially in patients with emergency cardiovascular like infarction myocardial I .

According to opinion researchers , correlation very strong negative ($r = -0.945$) indicates that level lactate blood own role important as indicator addition in evaluate condition oxygenation network in AMI patients . Although part big respondents own mark Relatively normal SpO_2 (95–99%), increased level lactate until reaching 4.5 mmol/L indicates that the process of hypoxia network Still can happen consequence decline perfusion , not solely Because low saturation oxygen arteries . With Thus , the examination SpO_2 should be No used as the only parameter in evaluate adequacy oxygenation network in AMI patients . Researchers have an opinion that combination inspection SpO_2 and levels lactate blood will give description more clinical comprehensive so that can help power health do detection early *occult tissue hypoxia* , determining level severity condition patients , as well as speed up taking decision therapy For increase external clinical patient .

CONCLUSION

Based on the results of research that has been conducted in the Intensive Care Room Care Unit of Dr. Wahidin Sudiro Husodo Mojokerto Regional General Hospital, it can be concluded that all respondents had oxygen saturation levels (SpO_2) within the normal range (100%) with a 95% Mean (CI) value of 96.50%–97.27% (minimum–maximum range 95%–99%). However, while the macro Oxygenation (SpO_2) parameters appeared completely

stable, the examination level lactate Blood tests showed that most respondents actually experienced hyperlactatemia (36.5% mild category) with a 95% mean lactate value (CI) of 2,451–2,972. mmol /L (lowest value range 1.1 mmol /L to a maximum of 4.5 mmol /L . The results of the statistical analysis were obtained with p-value = 0.000 ($p < 0.05$) with a correlation coefficient of $r = -0.945$. This proves that there is a very strong and negative relationship between oxygen saturation and blood lactate levels as a predictor. *Occult Tissue Hypoxia* (OTH) in Acute patients Myocardial Infarction (AMI). This finding strongly confirms that normal peripheral oxygen saturation values (normoxia) do not guarantee adequate oxygenation. and perfusion at the cellular level. Therefore, blood lactate level examination has been shown to be much more sensitive in early detection of occult tissue hypoxia (*Occult Tissue Hypoxia*) compared to pulse monitoring oximetry alone, so it is crucial to integrate it into the hemodynamic monitoring of critical AMI patients in the intensive care unit.

REFERENCES

- Bakker, J., Nijsten, M. W. N., & Jansen, T. C. (2013). Clinical Use Of Lactate Monitoring In Critically Ill Patients. *Annals of Intensive Care* , 3 (12), 1–8.
- Gajewski, P., Wilk, M.M., Aleksandrowicz, K., Ponikowska, B., & Zymliński, R. (2025). Lactate in Heart Failure. *International Journal of Molecular Sciences* , 26 , 1–11. <https://doi.org/https://doi.org/10.3390/ijms26146810>
- Gjesdal, G., Braun, O. Ö., Smith, J. G., Scherstén, F., & Tydén, P. (2018). Blood Lactate Is A Predictor Of Short-Term Mortality In Patients With Myocardial Infarction Complicated By Heart Failure But Without Cardiogenic Shock. *BMC Cardiovascular Disorders* , 18 (8), 1–8. <https://doi.org/10.1186/s12872-018-0744-1>
- Liu, H., Zhou, J., Liu, M., Liu, J., Luo, D., & Zhang, C. (2026). Lactate/Albumin Ratio Predicts 90-Day Mortality Of Cardiogenic Shock Patients. *Open Medicine* , 21 (1), 1–14. <https://doi.org/10.1515/med-2025-1355>
- Meier, P., Ebrahim, S., Otto, C., & Casas, J. P. (2013). Oxygen Therapy In Acute Myocardial Infarction – Good Or Bad? *Cochrane Library* , 8 , 1–2. <https://doi.org/https://doi.org/10.1002/14651858.ED000065>
- Severino, P., Amato, A.D., Prosperi, S., Fanisio, F., Birtolo, L.I., Costi, B., Netti, L., Chimenti, C., Lavallo, C., Maestrini, V., Mancone, M., & Fedele, F. (2021). Myocardial Tissue Characterization in Heart Failure with Preserved Ejection Fraction: From Histopathology and Cardiac Magnetic Resonance Findings to Therapeutic Targets. *International Journal of Molecular Sciences* , 22 (7650), 1–28. <https://doi.org/https://doi.org/10.3390/ijms22147650>

- Vermeulen, RP, Hoekstra, M., Nijsten, MWN, Horst, IC Van Der, Pelt, LJ Van, Jessurun, GA, Jaarsma, T., Zijlstra, F., & Heuvel, AF Van Den. (2010). Clinical correlates of arterial lactate levels in patients with ST-segment elevation myocardial infarction at admission : a descriptive study. *Critical Care* , 14 , 1–7.
- WHO. (2019). *Cardiovascular Disease* . WHO Western Pacific.
- Yu, Y., Wang, J., Wang, Q., Wang, J., Min, J., Wang, S., Wang, P., Huang, R., Xiao, J., Zhang, Y., & Wang, Z. (2020). Admission Oxygen Saturation And All-Cause In-Hospital Mortality In Acute Myocardial Infarction Patients : Data From The MIMIC-III Database. *Annals of Translational Medicine* , 8 (21), 1–14. <https://doi.org/10.21037/atm-20-2614>
- Zhang, H., Zhao, J., Yu, J., Zhang, X., Ran, S., Wang, S., Ye, W., Luo, Z., Li, Lactate Metabolism And Lactylation In Cardiovascular Disease: Novel Mechanisms And Therapeutic Targets. *Frontiers in Cardiovascular Medicine* , November , 1–13. <https://doi.org/10.3389/fcvm.2024.1489438>