Al-Azhar International Medical Journal

Volume 5 | Issue 7 Article 3

7-31-2024
Section: Internal Medicine

The value of Monocyte-to-lymphocyte Ratio as a Predictor for Acute Kidney Injury in Critically ill patients

Atef Abo-Elfotoh Ibrahim Mousa
Internal Medicine, Faculty of Medicine for Boys, Al-Azhar University, Cairo, Egypt

Hazem Sayed Ahmed AYoub
Internal Medicine, Faculty of Medicine for Boys, Al-Azhar University, Cairo, Egypt

Medhat Ali Salah Abd ELghaffar
Clinical Pathology, Faculty of Medicine for Boys, Al-Azhar University, Cairo, Egypt

Amr Samir Hassan Samara
Internal Medicine, Faculty of Medicine for Boys, Al-Azhar University, Cairo, Egypt, amrsamara@gmail.com

How to Cite This Article

Mousa, Atef Abo-Elfotoh Ibrahim; AYoub, Hazem Sayed Ahmed; Abd ELghaffar, Medhat Ali Salah; and Samara, Amr Samir Hassan (2024) "The value of Monocyte-to-lymphocyte Ratio as a Predictor for Acute Kidney Injury in Critically ill patients," *Al-Azhar International Medical Journal*: Vol. 5: Iss. 7, Article 3.
DOI: https://doi.org/10.58675/2682-339X.2521

ORIGINAL ARTICLE

The value of Monocyte-to-lymphocyte Ratio as a Predictor for Acute Kidney Injury in Critically ill patients

Atef A. I. Mousa [a], Hazem S. A. Ayoub [a], Medhat A. S. Abd ELghaffar [b], Amr S. H. Samara [a,*]

[a] Department of Internal Medicine, Faculty of Medicine for Boys, Al-Azhar University, Cairo, Egypt
[b] Department of Clinical Pathology, Faculty of Medicine for Boys, Al-Azhar University, Cairo, Egypt

Abstract

Background: ***Prediction and early intervention for Acute kidney injury (AKI) are crucial since it may cause long-term mortality and irreversible renal damage.***

Aim and objectives: ***To determine the diagnostic, prognostic significance of the Monocyte-to-lymphocyte ratio (MLR) in the early identification of acute renal injury in critically ill individuals.***

Patients and methods: ***This prospective study included one hundred critically ill cases at the intensive care unit (ICU) of Damanhur Medical National Institute (DMNI) and ELhussein Hospital. They were classified into 2 groups: The non-AKI group was comprised of 50 persons, and the AKI group included 50 patients. The trial length was six months.***

Results: ***Regarding lymphocytes, monocytes & base MLR, both groups that were compared demonstrated a statistically significant distinction. There was no statistically significant variance amongst the studied groups regarding urine output day (0). At the same time, there was a highly statistically significant variance among the two studied groups regarding urine output day (1) and urine output day (2).***

Conclusion: ***MLR has valuable diagnostic and predictive significance in the early diagnosis of acute renal damage in extremely sick individuals, as our study found statistically significant changes among both groups in lymphocytes, monocytes, serum creatinine, base MLR, and urine output. Univariate logistic regression analysis revealed a significant connection between AKI incidence as well as Base MLR, S. Creat Day 2, The First Day of Urine Output, and Output of Urine on the second day, and between AKI incidence and S. Creat Day 2, Urine Output Day 1, and Urine Output Day 2.***

Keywords: AKI, MLR, Serum creatinine

1. Introduction

Complex clinical conditions, for example, acute kidney damage, are common among individuals in the intensive care unit. Given that AKI has the potential to induce both permanent kidney damage as well as mortality in the long run, its prediction and early intervention are of the utmost importance. However, there is minimal usefulness in using urine volume and serum creatinine (Scr) levels for early identification of AKI, the current diagnostic methods.[1, 2]

A rising several research that is observational have tried to uncover clinical markers for the estimation of mortality in people with AKI because of the high frequency of AKI in the ICU and its poor prognosis. Research has been conducted on a wide variety of novel biomarkers, such as Cystatin C (Cyst C) as well as neutrophil gelatinase-associated lipocalin (NGAL), to figure out whether or not they could be utilized in the early diagnosis of acute kidney injury. However, their use in clinical practice has yet to be commonly utilized. Therefore, it is crucial from a clinical point of view to identify the optimum biomarkers for AKI diagnosis.[3,4,5]

The development and progression of AKI are highly affected by inflammation. In individuals with acute kidney injury, one of the most prevalent symptoms is an altered shape and functioning of vascular endothelial cells. Monocyte-to-lymphocyte ratio (MLR) and neutrophil-to-lymphocyte ratio (NLR) are reliable inflammatory indicators calculated from complete blood counts. According to reports, the neutrophil-to-lymphocyte ratio has also been linked to the development of AKI. Uncertainty still exists about MLR's contribution to the occurrence and prognosis of AKI.[6,7]

Accepted 21 July 2024.
Available online 31 July 2024

* Corresponding author at: Internal Medicine, Faculty of Medicine for Boys, Al-Azhar University, Cairo, Egypt.
E-mail address: amrsamara@gmail.com (A. S. H. Samara).

https://doi.org/10.58675/2682-339X.2521

The target of this trial was to identify the diagnostic in addition to prognostic value of Monocyte-to-lymphocyte ratio in early detection of acute kidney injury in critically ill persons.

2. Patients and methods

This prospective trial contained one hundred patients in serious condition at the intensive care unit of Damanhur Medical National Institute & EL Hussein Hospital. AKI stage 1 diagnosis was based on the KDIGO classification definition, and cases were subsequently stratified into two groups: The non-AKI group included fifty individuals, and the acute kidney injury group involved the same number of patients in the 1st group. Before being taken to the intensive care unit, the baseline creatinine value was the smallest number identified in the emergency clinic or general ward. Six months were the length of the research.

Inclusion criteria: Patients with normal serum creatinine at time of admission to the ICU

Exclusion criteria: individuals who were 18 years old or younger, patients with a diagnosis of chronic kidney disease, patients with a known history of SLE or rheumatoid diseases, end-stage renal disease cases on dialysis, persons with a history of kidney transplantation, and individuals lacking renal function or blood routine test results within 48 hours of being admitted to the ICU.

Methods:

All cases were underwent Complete history taking, physical examinations, and radiological investigation: Ultrasound of the abdomen and pelvis, Transabdominal Ultrasound, and pelvic Ultrasound.

Monocyte to Lymphocyte ratio: The technique for measuring the Monocyte to Lymphocyte ratio (MLR) involved obtaining a blood sample from the patient and performing laboratory tests to determine monocyte and lymphocyte level. The steps involved in this process:

Blood sample collection: A blood sample was collected from the patient using a needle and syringe. The sample is typically collected from a vein in the arm and immediately transferred to the lab for analysis. Laboratory testing: The laboratory performed a complete blood count (CBC) to determine the total white blood cell count and the level of monocyte and Lymphocyte in the sample. Calculation of MLR: The MLR was calculated by dividing the level of the monocyte by the lymphocyte level—interpretation of results.

Blood collection and sampling: The people's blood was collected from their veins. The skin was sterilized using alcohol.

A tourniquet was put on either at the upper mid-arm or on the back of the hand. A blood sample was gathered using a syringe. The tourniquet was detached, and the needle was extracted from the vein. We used EDTA tube to prevent coagulation for CBC and a Chemistry empty tube for Serum Albumin – S, Creatinine – Blood Urea – S.Sodium – S.potassium – CRP. For serum creatinine and albumin, we centrifuged blood samples at 3500 turn/minute to obtain clear serum, and then we used it to detect them. (Vacuette).

Complete blood count (CBC): a Celtic Alfa (Nihon Kohden Cell Counter): Automated Hematology Analyzer analyzed the CBC. By taking a sample of whole blood

Method: Electrical Impedance, DynaHelix Flow technology.

Ethical Consideration: After explaining the trial design, anticipated benefits, and possible risks, written consent was obtained from all participants. We hide the patient's name when we use the research. The research results were used only for scientific purposes. All procedures followed the Al-Azhar University Ethics Committee Regulations.

3. Results

Table 1 indicated that there was no statistically significant variance amongst both studied groups as regards age & gender.

Table 1. Demographic data amongst the study population

	AKI GROUP (N = 50)	NON-AKI GROUP (N = 50)	TEST OF SIG.	P
AGE (YEARS)			t = -0.74	0.461
MEAN ± SD.	63.28 ± 6.26	64.2 ± 6.17		
MEDIAN (IQR)	63.5 (58 - 68)	65 (59 - 69)		
RANGE (MIN-MAX)	24 (50 - 74)	23 (52 - 75)		
GENDER			X2 = 0.36	0.548
- MALE	23 (46%)	26 (52%)		
- FEMALE	27 (54%)	24 (48%)		

x2: Chi- Square test SD: standard deviation IQR: interquartile range, t: Independent T test, p: p value for comparing between the studied groups: P-value > 0.05: Non-significant; P-value < 0.05: Significant; P-value < 0.001: Highly significant

Table 2 displayed that there was a highly statistically significant alteration among each of studied groups concerning Lymphocytes, Monocytes & Base MLR.

Table 2. Monocytes, Lymphocytes in addition to Monocyte-to-lymphocyte ratio among the trial population

	AKI GROUP (N = 50)	NON-AKI GROUP (N = 50)	TEST OF SIG.	P
MONOCYTES (X10^9/L)			t = 11.149	<0.001
MEAN ± SD.	1.45 ± 0.46	0.6 ± 0.29		
MEDIAN (IQR)	1.38 (1.12 - 1.67)	0.54 (0.33 - 0.76)		
RANGE (MIN-MAX)	2.16 (0.71 - 2.87)	1.26 (0.14 - 1.4)		
LYMPHOCYTES (X10^9/L)			t = 3.783	<0.001
MEAN ± SD.	1.7 ± 0.26	1.46 ± 0.36		
MEDIAN (IQR)	1.67 (1.5 - 1.85)	1.43 (1.11 - 1.7)		
RANGE (MIN-MAX)	1.21 (1.2 - 2.41)	1.58 (0.72 - 2.3)		
BASE MLR			t = 20.123	<0.001
MEAN ± SD.	0.84 ± 0.13	0.39 ± 0.09		
MEDIAN (IQR)	0.82 (0.74 - 0.91)	0.38 (0.3 - 0.45)		
RANGE (MIN-MAX)	0.6 (0.59 - 1.19)	0.42 (0.19 - 0.61)		

Table 3 presented that there was no significant alteration amongst the two studied groups concerning Serum Creatinine Day (0). There was a highly statistically variance amongst the two studied groups regarding serum creatinine Day (2).

Table 3. Serum Creatinine at Day (0) & (2) amongst the examined population

	AKI GROUP (N = 50)	NON-AKI GROUP (N = 50)	TEST OF SIG.	P
SERUM CREATININE DAY (0)			t = 1.055	0.063
MEAN ± SD.	1 ± 0.05	0.94± 0.22		
MEDIAN (IQR)	0.95 (0.91 – 0.98)	0.92 (0.89 - 0.99)		
RANGE (MIN-MAX)	0.2 (0.9 – 1.1)	0.93 (0.86 - 1)		
SERUM CREATININE DAY (2)			t = 21.462	<0.001
MEAN ± SD.	1.8± 0.07	0.9 ± 0.03		
MEDIAN (IQR)	1.76 (1.66 - 1.88)	0.85 (0.84 - 0.91)		
RANGE (MIN-MAX)	0.3 (1.64 - 1.94)	0.16 (0.8 - 0.96)		

Table 4 indicated that there was no statistically change among each of groups regarding CRP & estimated glomerular filtration rate, while there was highly significant variance amongst both studied groups With regard to blood urea.

Table 4. Kidney function test results among the study population

	AKI GROUP (N = 50)	NON-AKI GROUP (N = 50)	TEST OF SIG.	P
BLOOD UREA			t = 14.23	≤0.001
MEAN ± SD.	51.5 ± 6.75	33.48 ± 5.86		
MEDIAN (IQR)	52.5 (39 - 56)	33.5 (28 - 38)		
RANGE (MIN-MAX)	44 (22 - 66)	21 (22 - 43)		
CRP			t = 0.81	0.42
MEAN ± SD.	47.52 ± 40.86	40.88 ± 41.07		
MEDIAN (IQR)	24.5 (12 - 83.5)	17 (12 - 61.5)		
RANGE (MIN-MAX)	160 (4 - 164)	194 (8 - 202)		
EGFR			t = -0.574	0.567
MEAN ± SD.	91.96 ± 10.58	93.22 ± 11.35		
MEDIAN (IQR)	95 (85.5 - 99)	96 (87.25 - 100)		
RANGE (MIN-MAX)	42 (67 - 109)	44 (70 - 114)		

Table 5 displayed that In terms of urine output day (0), no statistically significant distinction existed among the two groups that were tested, while there was a highly statistical variance among both studied groups regarding urine output day (1) & urine output day (2).

Table 5. Urine output at Day (0), (1) and (2) among the study population

	AKI GROUP (N = 50)	NON-AKI GROUP (N = 50)	TEST OF SIG.	P
URINE OUTPUT DAY (0)			t = 1.885	0.062
MEAN ± SD.	1730± 60	1750 ± 45		
MEDIAN (IQR)	1680 (1650 - 1700)	1755 (1720 - 1790)		
RANGE (MIN-MAX)	120 (1600 -1720)	100 (1700 - 1800)		
URINE OUTPUT DAY (1)			t = 51.351	<0.001
MEAN ± SD.	1050± 74.9	1700± 49		
MEDIAN (IQR)	1035(960 - 1140)	1650 (1640 - 1730)		
RANGE (MIN-MAX)	300 (900 - 1200)	200 (1600 - 1800)		
URINE OUTPUT DAY (2)			t = 89.770	<0.001
MEAN ± SD.	900.5 ± 50	1800 ± 50.2		
MEDIAN (IQR)	890 (840-940)	1780 (1750 - 1850)		
RANGE (MIN-MAX)	200 (800 - 1000)	200 (1700 - 1900)		

Table 6 indicated univariate logistic regression analysis with odds ratios & 95% confidence intervals predicting AKI incidence. There was a significant logistic regression relationship amongst AKI incidence and base MLR, S.Creat Day (2), urine output day (1) and urine output day (2).

Table 6. Univariate logistic regression analysis with odds ratios and 95% confidence intervals (CI) predicting AKI incidence

	AKI INCIDENCE			
	OR	95% CI		P
		Lower	Upper	
BASE MLR				
	1.4×10^{22}	1.9×10^{6}	1.1×10^{38}	0.006
S.CREAT DAY (2)				
	1.0×10^{9}	9.1×10^{3}	1.1×10^{14}	<0.001

URINE OUTPUT DAY (1)				
	0.997	0.995	0.998	<0.001
URINE OUTPUT DAY (2)				
	0.996	0.995	0.998	<0.001

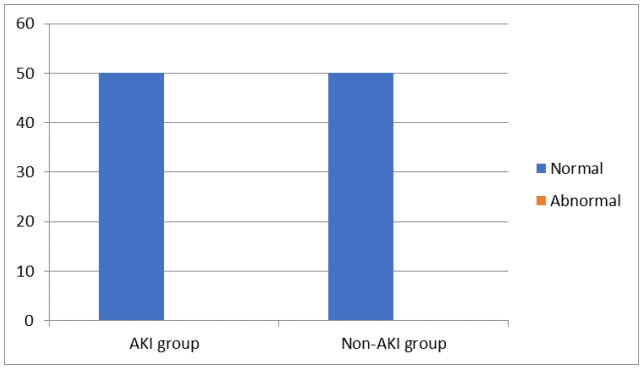

Figure 1. Bar chart viewing comparison among the study groups regarding ultrasonography (US) kidney.

Regarding US kidney, all patients in the two studied groups had normal US kidney imaging test result.

4. Discussion

Based on our findings, neither group varied significantly from the other in terms of age or gender.

Our outcomes agreed with Yilmaz et al.[8] In their study of individuals with severe sepsis, the researchers looked at the neutrophil-lymphocyte ratio as a potential risk factor for acute kidney injury. They observed no statistical disparity in gender among the two groups (p = 0.823).

When comparing both groups, we noticed that monocytes, lymphocytes, as well as base MLR were significantly distinct.

The findings were in agreement with Jiang et al.,[9] who discovered that the two groups did not differ statistically concerning white blood cell count (p-value = 0.786) but differed significantly concerning mean lymphocyte count (p-value = (<0.001)).

Our outcomes differed from those of Liu et al.[10] who noted that the white blood cell count for those with AKI was much higher than that of the non-AKI group.

Regarding Serum Creatinine at days (0) and (2), our results indicated that there was no statistically significant variance among both studied groups regarding Serum Creatinine day (0). There was a statistical variance amongst the two studied groups regarding Serum Creatinine Day (2).

Our outcomes agreed with Chen et al,[11] who identified no significant disparity in Serum Creatinine levels among the two groups on day 0 (P-value= 0.069).

Our findings are at variance with Jiang et al,[9] By the paper; there was an extremely significant variance (p-value = <0.001) in baseline serum creatinine levels among the AKI and non-AKI groups.

Our findings demonstrated a statistical variation in blood urea levels among both groups but no variation in C-reactive protein or estimated glomerular filtration rate (eGFR) in kidney function tests.

Our outcomes agreed with Liu et al.,[10] identified that AKI participants' BUN levels were significantly greater than those of the non-AKI people.

Our outcomes disagreed with Chen et al.,[11] who detected no statistically distinction in blood urea levels among each group (p-value= 0.307).

Our data indicated no significant disparity among the two groups in terms of urine output day (0). However, there was a significant variance in urine output on days one and two.

Our outcomes agreed with Macedo et al.[12] which determined that those suffering from acute kidney injury had lower urine output and higher daily and cumulative fluid balance during the disease's development phase. The evaluation aimed to determine whether these variables behaved as independent predictors of mortality in adult intensive care unit individuals.

Regarding US kidney imaging test results among the research population, all cases in the two studied groups had normal US kidney imaging tests with no nephropathic abnormalities.

Our results disagreed with Liu et al.,[13] who set out to assess ultrasonography for individuals suffering from acute kidney damage and the association among US results and the clinical features of AKI, revealing that 111 patients with AKI had their US features examined. Participants with AKI exhibited more extended kidneys and larger kidney volumes than the control group (P<0.05). Acute renal injury individuals also had thicker parenchyma compared to the control group, however, the difference was only statistically significant for the right kidney. Hydronephrosis, elevated renal resistance index (RRI), as well as raised parenchymal echogenicity, were observed in thirty-eight out of 111 individuals with acute kidney injury who had US examinations. Only five individuals exhibited elevated renal resistance index.

Regarding univariate logistic regression analysis with odds ratios and 95% confidence intervals predicting AKI incidence, our results showed a significant logistic regression relationship between acute kidney injury incidence and Base MLR. There was also a highly significant logistic regression relationship between AKI incidence and S. Creat in 2nd Day, Urine output day (1),

and Urine output day two.

Our results agreed with Jiang et al.[9] who testified that Logistical regression designated that MLR tied to the prevalence of AKI in persons who were critically ill, p<0.001; MLR is a reliable biomarker in predicting the occurrence of acute kidney injury in ICU cases.

4. Conclusion

MLR has valuable diagnostic and prognostic value in early detection of acute kidney injury in critically ill patients, as our study found a significant variance amongst both groups in monocytes, lymphocytes, base MLR, serum creatinine, and urine output. Univariate logistic regression analysis revealed a significant association among AKI incidence and Base MLR, S.Creat Day 2, Urine Output Day 1, and Urine Output Day 2, and between AKI incidence and S.Creat Day 2, Urine Output Day 1, and Urine Output Day 2.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Authorship

All authors have a substantial contribution to the article

Funding

No Funds : Yes

Conflicts of interest

There are no conflicts of interest.

References

1. 1. Levey AS, James MT. Acute Kidney Injury [published correction appears in Ann Intern Med. 2017;167(9):ITC66-ITC80.
2. Pakula AM, Skinner RA. Acute Kidney Injury in the Critically Ill Patient: A Current Review of the Literature. J Intensive Care Med. 2016;31(5):319-324
3. Cerdá J. A biomarker able to predict acute kidney injury before it occurs?. Lancet. 2019;394(10197):448-450
4. Parikh CR, Liu C, Mor MK, et al. Kidney Biomarkers of Injury and Repair as Predictors of Contrast-Associated AKI: A Substudy of the PRESERVE Trial. Am J Kidney Dis. 2020;75(2):187-194
5. Tanase DM, Gosav EM, Radu S, et al. The Predictive Role of the Biomarker Kidney Molecule-1 (KIM-1) in Acute Kidney Injury (AKI) Cisplatin-Induced Nephrotoxicity. Int J Mol Sci. 2019;20(20):5238
6. Choi YH, Lee JW, Lee SH, et al. A High Monocyte-to-Lymphocyte Ratio Predicts Poor Prognosis in Patients with Advanced Gallbladder Cancer Receiving Chemotherapy. Cancer Epidemiol Biomarkers Prev. 2019;28(6):1045-1051
7. Bu X, Zhang L, Chen P, Wu X. Relation of neutrophil-to-lymphocyte ratio to acute kidney injury in patients with sepsis and septic shock: A retrospective study. Int Immunopharmacol. 2019;70:372-377
8. Yilmaz H, Cakmak M, Inan O, Darcin T, Akcay A. Can neutrophil-lymphocyte ratio be independent risk factor for predicting acute kidney injury in patients with severe sepsis?. Ren Fail. 2015;37(2):225-229
9. Jiang F, Lei J, Xiang J, et al. Monocyte-to-lymphocyte ratio: a potential novel predictor for acute kidney injury in the intensive care unit. Ren Fail. 2022;44(1):1004-1011
10. Liu S, Li M, Yang Y, Chen Y, Wang W, Zheng X. A novel risk model based on white blood cell-related biomarkers for acute kidney injury prediction in patients with ischemic stroke admitted to the intensive care unit. Front Med (Lausanne). 2022;9:1043396
11. Chen Y, Dong K, Fang C, et al. The predictive values of monocyte-lymphocyte ratio in postoperative acute kidney injury and prognosis of patients with Stanford type A aortic dissection. Front Immunol. 2023;14:1195421
12. Macedo E, Bouchard J, Soroko SH, et al. Fluid accumulation, recognition and staging of acute kidney injury in critically-ill patients. Crit Care. 2010;14(3):R82
13. Liu C, Wang X. Clinical utility of ultrasonographic evaluation in acute kidney injury. Transl Androl Urol. 2020;9(3):1345-1355