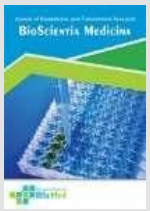
eISSN (Online): 2598-0580



Bioscientia Medicina: Journal of Biomedicine & Translational Research

Journal Homepage: www.bioscmed.com

The Effect of Intravenous Essential Amino Acid Supplementation on Recovery of Kidney Function in Acute Kidney Injury Patients at Dr. Mohammad Hoesin General Hospital, Palembang, Indonesia

Maya Sari[1*], Novadian[1], Yulianto Kusnadi[2]

[1]Division of Kidney Hypertension, Department of Internal Medicine, Faculty of Medicine, Universitas Sriwijaya/Dr. Mohammad Hoesin General Hospital, Palembang, Indonesia

[2]Division of Metabolic Endocrine, Department of Internal Medicine, Faculty of Medicine, Universitas Sriwijaya/Dr. Mohammad Hoesin General Hospital, Palembang, Indonesia

ARTICLE INFO

Keywords:
Acute kidney injury
Creatinine
Efficacy
Amino acid supplements

***Corresponding author:**
Maya Sari

E-mail address:
msari2540@gmail.com

All authors have reviewed and approved the final version of the manuscript.

https://doi.org/10.37275/bsm.v7i1.759

A B S T R A C T

Background: Acute kidney injury (AKI) is a clinical condition characterized by a rapid decline in kidney function that causes homeostatic failure in regulating fluid, electrolyte, and acid-base balance within hours to days. Nutritional supplementation is effective in replacing lost protein and as an energy reserve. This study aimed to determine the effect of intravenous essential amino acid supplementation on the recovery of kidney function in acute kidney injury patients at Dr. Mohammad Hoesin General Hospital, Palembang, Indonesia. **Methods:** This study is an open clinical trial of experimental research. A total of 34 research subjects participated in this study, where the subjects were grouped into treatment (IV amino acid supplementation) and placebo groups. Data analysis was carried out using STATA in univariate and bivariate. **Results:** Administration of amino acid supplements can reduce creatinine by 1.36. Meanwhile, the placebo was unable to reduce creatinine levels and even caused an increase in creatinine by 0.26. **Conclusion:** Intravenous administration of essential amino acid supplements has an effect on the recovery of kidney function in acute kidney injury patients at Dr. Mohammad Hoesin General Hospital, Palembang, Indonesia.

1. Introduction

Acute kidney injury (AKI) is a clinical condition characterized by a rapid decline in kidney function that causes homeostatic failure in regulating fluid, electrolyte, and acid-base balance within hours to days. AKI, which affects up to half of the critically ill patients, is closely related to both short and long-term mortality and morbidity. The mechanism thought to play a role in this is a multi-organ failure, such as the brain and other organs, through decreased renal clearance of drugs, metabolites, and other potential neurotoxins. The resulting metabolic complications stem from decreased excretory capacity and increased catabolism. The rapid process of gluconeogenesis in AKI patients and the breakdown of structural proteins results in the release of both organic and inorganic metabolic products into the intravascular space. Morbidity and mortality often result from accumulated concentrations of these substances, such as hyperkalemia, which play a role in the pathophysiology of cardiotoxicity.[1-5]

Nutritional supplementation is effective in replacing lost protein and as an energy reserve. Several studies have shown that protein/amino acid supplementation is associated with improved nutritional status through increased serum albumin levels. A study showed that amino acid supplementation in a patient who had AKI and severe abdominal trauma due to a severe traffic accident, where L-essential amino acid administration for 25 days helped the patient restore the weight lost during treatment, wound healing, and positive nitrogen balance. Rapid response, with stable blood urea levels and disappearance of uremia symptoms.[6-9] This study aimed to determine the effect of intravenous essential amino acid supplementation on the recovery of kidney function in acute kidney injury patients at Dr. Mohammad Hoesin General Hospital, Palembang, Indonesia.

2. Methods

This study is an experimental study with an open clinical trial design. This study was conducted in the intensive care unit (ICU) and the inpatient ward of the Internal Medicine Section of Dr. Mohammad Hoesin General Hospital, Palembang, Indonesia. A total of 34 research subjects participated in this study. The inclusion criteria were subjects aged >18 years who were diagnosed with AKI based on KDIGO criteria in the ICU or inpatient ward, and the subject and/or patient's family received information regarding the explanation of the study and expressed willingness to participate in the study by signing informed consent. The research subjects were grouped into the treatment group and the placebo group. The treatment group was a group of IV fluids infusion of amino acids-L100 g/L given to patients in the intervention group (providing supplementation with a maximum of 100 grams of amino acids per day) for 3 days. This study was approved by the medical and health research ethics committee at Dr. Mohammad Hoesin General Hospital, Palembang, Indonesia.

Before and after the intervention, an examination was carried out to assess kidney function. Assessment of kidney function is done by measuring creatinine levels. Data analysis was carried out using STATA software version 14.0. Univariate analysis for categorical data is presented in the form of frequency distribution using percentages or proportions. Numeric data will be presented in the form of mean or standard deviation. Bivariate analysis for categorical data was aimed at examining differences in the proportion of recovered and non-recovered AKI patients in the intervention and placebo groups, with a p-value <0.05.

3. Results

Table 1 presents the general characteristics of the research subjects. The majority of research subjects are female. The majority of subjects had a history of high school education and had a normal body mass index. Table 2 presents the distribution of comorbidities and AKI etiology of the study subjects. The majority of research subjects had comorbid dehydration and infection. Of the research subjects, the majority had prerenal AKI etiology.

4. Discussion

In a clinical trial of 53 critically ill patients, it was found that intravenous administration of amino acids could provide a faster AKI healing time. Another clinical trial of 14 critically ill patients with creatinine clearance of less than 50 mL/min showed that the intervention group who received higher doses of amino acids had improved diuresis and required lower doses of furosemide. A sub-group analysis of a cluster RCT aimed at evaluating nutritional guidelines in 242 critically ill patients who were at high risk for renal dysfunction at admission found that significantly higher daily protein intake put these patients at lower risk of needing RRT (Renal replacement therapy).

Table 1. General characteristics of research subjects.

	Group		
	Total (n=34)	Amino acid supplements (n=17)	Placebo (n=17)
Age	54.0 (22-70)	54 (24-70)	55 (22-65)
Gender			
Male	13 (38.2 %)	6 (35.3 %)	7 (41.2%)
Female	21 (61.8 %)	11 (64.7 %)	10 (58.8 %)
Education			
Primary school	6 (17.6 %)	4 (23.5%)	2 (11.8 %)
Junior high school	7 (20.6 %)	4 (23.5 %)	3 (17.6 %)
Senior high school	15 (44.1 %)	8 (47.1 %)	7 (41.2 %)
College	6 (17.6 %)	1 (5.9 %)	5 (29.4%)
IMT			
Underweight	9 (26.5 %)	6 (35.3%)	3 (17.6 %)
Normal	25 (73.5%)	11 (64.7 %)	14 (82.4 %)

Table 2. Distribution of comorbidities related to the intervention group.

	Group			Etiology	
	Total (n=34)	**Amino acid supplements (n=17)**	**Placebo (n=17)**	**Prerenal (n=18)**	**Renal (n=16)**
Dehydration	8 (23.5%)	4 (23.5%)	4 (23.5%)	4 (22.2%)	4 (25%)
Malnutrition	5 (14.7%)	2 (11.8%)	3 (17.6%)	4 (22.2%)	1 (6.3%)
Infection	7 (20.6%)	3 (17.6%)	4 (23.5%)	4 (22.2%)	3 (18.8%)
SLE	1 (2.9%)	1 (5.9%)	0 (0%)	0 (0%)	1 (6.3%)
HHD	5 (14.7%)	3 (17.6%)	2 (11.8%)	3 (16.7%)	2 (12.5%)
Drugs	2 (5.9%)	2 (11.8%)	0 (0%)	1 (5.6%)	1 (6.3%)
CHF	2 (5.9%)	1 (5.9%)	1 (5.9%)	0 (0%)	2 (12.5%)
CAD	2 (5.9%)	0 (0%)	2 (11.8%)	1 (5.6%)	1 (6.3%)
Anemia	2 (5.9%)	1 (5.9%)	1 (5.9%)	1 (5.6%)	1 (6.3%)

Table 3 presents a comparison of creatinine levels between groups. The results of the study showed that the provision of amino acid supplements was able to reduce creatinine by 1.36. Meanwhile, the placebo was unable to reduce creatinine levels and even caused an increase in creatinine by 0.26.

Table 3. Comparison of creatinine levels and its changes between groups.

	Group								
	Amino acid supplements (n=17)				**Placebo (n=17)**				**p'**
	Before	**After**	**Change**	**p**	**Before**	**After**	**Change**	**p**	
Creatinine	3.23± 1.71	1.87± 1.11	1.36	0,001[a]	2.60± 0.56	2.86± 1.47	-0.26	0.492[a]	0,04[b]

p: p-value before and after treatment. p': p-value after treatment between groups. a) Wilcoxon test b) Unpaired T test, significant if $p<0.05$.

In comparison, a study of 474 critically ill patients found no main outcome difference in the form of the duration of kidney dysfunction between the intervention group and the control group (mean difference 0.21 days AKI, 95% CI -0.27-1.04; P=0.45), even though the amino acid intervention was significantly improved eGFR (treatment group x time interaction; P=0.004), with a peak difference of 7.7 mL/min/1.73m^2 (95% CI 1.0-14.5 mL/min/1.73m^2). Daily urine output was also significantly increased (+300 mL/d, 95% CI 145-455 mL; P=0.0002). Different results were shown by clinical trials that compared the

dose of amino acid supplementation in addition to the daily caloric intake of 2000 kcal (group 1 = 75 g; group 2 = 150 g). The results showed a significant difference in nitrogen balance between the two groups ($p < 0.01$), balanced daily fluids, and required a lower dose of furosemide ($p<0.05$). However, this clinical trial only included 14 patients, so the internal validity of the study was in doubt. eGFR increase and enhancement of urine output, possibly indicating that the hyperfiltration response to amino acids may be maintained in critically ill patients in general.[10-15]

A randomized controlled trial (RCT) performed in adult patients undergoing cardiac surgery demonstrated that amino acid infusions started immediately after surgery significantly increased renal blood flow, GFR, and renal oxygen consumption in this patient population. Animal models show that the resulting increase in renal blood flow after eating protein can protect the kidney from acute ischemic threats. Intravenous amino acid infusions are known to have an effect on renal hemodynamics. High protein intake results in afferent arteriolar vasodilatation and decreased renal vascular resistance with consequent increased renal blood flow. As feedback, the glomerular filtration rate (GFR) increases up to 35% above the baseline GFR.[16-20]

5. Conclusion

Intravenous administration of essential amino acid supplements has an effect on the recovery of kidney function in acute kidney injury patients at Dr. Mohammad Hoesin General Hospital, Palembang, Indonesia.

6. References

1. Williams H, Mafrici B. Nutritional considerations in adult patients with acute kidney injury. Journal of Kidney Care. 2017; 1–15.
2. Goldstein SL, Kane-gill SL, Liu KD, Prowle JR. Disease: Improving global outcomes (KDIGO) Conference. 2021; 98: 294–309.
3. Rewa O. Bagshaw SM. Acute kidney injury-epidemiology, outcomes and economics. Nat Rev Nephrol. 2014; 10: 193–207.
4. De Mendonça A, et al. Acute renal failure in the ICU: Risk factors and outcome evaluated by the SOFA score. Intensive Care Med. 2000; 26: 915–21.
5. Hoste EAJ, et al. Global epidemiology and outcomes of acute kidney injury. Nat Rev Nephrol. 2018; 14: 607–25.
6. Susantitaphong P, et al. World incidence of AKI: A meta-analysis. Clin J Am Soc Nephrol. 2013; 8: 1482–93.
7. Luo X, et al. A comparison of different diagnostic criteria of acute kidney injury in critically ill patients. Crit Care. 2014; 18: 1–8.
8. Roesli RM. Diagnosis and management of acute kidney injury. Jakarta: Puspa Swara. 2008.
9. Siew ED, et al. Acute kidney injury as a risk factor for delirium and coma during critical illness. Am J Respir Crit Care Med. 2017; 195: 1597–607.
10. Abel RM, Shih VE, Abbott WM, Beck VH, Fischer JE. Amino acid metabolism in acute renal failure: Influence of intravenous essential L-Amino Acid Hyperalimentation Therapy. Ann Surg. 1973.
11. Abel RM, Beck CH, Abbott WM. Treatment of acute renal failure with intravenous administration of essential amino acids and glucose. Surg Forum. 1972; 23: 77–9.
12. Ostermann M, et al. Micronutrients in critically ill patients with severe acute kidney injury – a prospective study. Sci Rep. 2020; 10: 1–13.
13. Matsuzawa R, et al. The effects of amino acid/protein supplementation in patients undergoing hemodialysis: A systematic review and meta-analysis of randomized controlled trials. Clin Nutr. ESPEN. 2021; 44: 114–21.
14. Pickkers P, et al. Acute kidney injury in the critically ill: an updated review on pathophysiology and management. Intensive Care Med. 2021; 47: 835–50.

15. Cano N, et al. ESPEN guidelines on enteral nutrition: Adult renal failure. Clin Nutr. 2006; 25: 295–310.
16. Fiaccadori E, Regolisti G, Cabassi A. Specific nutritional problems in acute kidney injury, treated with non-dialysis and dialytic modalities. NDT Plus. 2010; 3: 1–7.
17. Carrero JJ, et al. Global prevalence of protein-energy wasting in kidney disease: A meta-analysis of contemporary observational studies from the international society of renal nutrition and metabolism. J Ren Nutr. 2018; 28: 380–92.
18. Ikizler TA, et al. Prevention and treatment of protein energy wasting in chronic kidney disease patients: a consensus statement by the International Society of Renal Nutrition and Metabolism. Kidney Int. 2013; 84: 1096–107.
19. Liu PJ, Ma F, Wang QY, He SL. The effects of oral nutritional supplements in patients with maintenance dialysis therapy: A systematic review and meta-analysis of randomized clinical trials. PLoS One. 2018; 13: 1–17.
20. Mah JY, et al. Oral protein-based supplements versus placebo or no treatment for people with chronic kidney disease requiring dialysis. Cochrane Database Syst Rev. 2020; 2020.