Renoprotective Effect of Intravenous Amino Acid Infusion in Adult Patients Undergoing Cardiac Surgery: A Systematic Review and Meta-Analysis

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BACKGROUND

AKI: A Critical Public Health Challenge

- Philippines prevalence **(35.94%)** significantly exceeds global rates (9.1-13.4%).

Post-Cardiac Surgery AKI

- Incidence: **5-42%** of cardiac surgery patients
- Even minor creatinine increases (0.3-0.5 mg/dL) linked to higher 30-day mortality
- Severe cases requiring RRT: **1-5%** of patients (mortality up to 63%)

Suriyong P, Ruengorn C, Shayakul C, Anantachoti P, Kanjanarat P. Prevalence of chronic kidney disease stages 3–5 in low- and middle-income countries in Asia: A systematic review and meta-analysis. PLoS One. 2022;17(2):e0264393.

Vives M, Hernandez A, Parramon F, Estanyol N, Pardina B, Muñoz A, et al. Acute kidney injury after cardiac surgery: prevalence, impact and management challenges. Int J Nephrol Renovasc Dis. 2019;12:153-166.

OBJECTIVE

To provide a comprehensive assessment of the intervention of amino acid infusion versus standard of care in reducing the **incidence of AKI**, **the need to initiate renal replacement therapy**, and **30-day mortality** among patients undergoing cardiac surgery.

RESEARCH QUESTION

Among adult patients undergoing cardiac surgery, what is the effect of giving intravenous amino acid infusion versus the standard of care alone in preventing AKI, reducing the need to initiate RRT, and lowering 30-day mortality?

PIOM

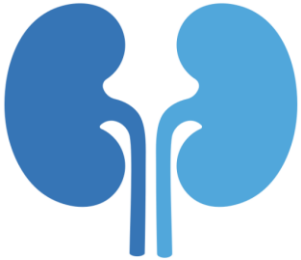
Population

Adult patients undergoing cardiac surgery

Intervention

Control:
Standard of Care

Intervention: Amino Acid
- L-amino acids: 2 gm/kg of IBW for 3 days
- L-amino acids: 60 g/day for 3 days



Outcome

Post-Cardiac Surgery
1.) AKI (Stage I, II, III)
2.) Need to initiate RRT
3.) 30-Day Mortality

Method

Open Label Randomized-Controlled Trials

METHODS
(Search Strategy)

Duration

Until November 2025

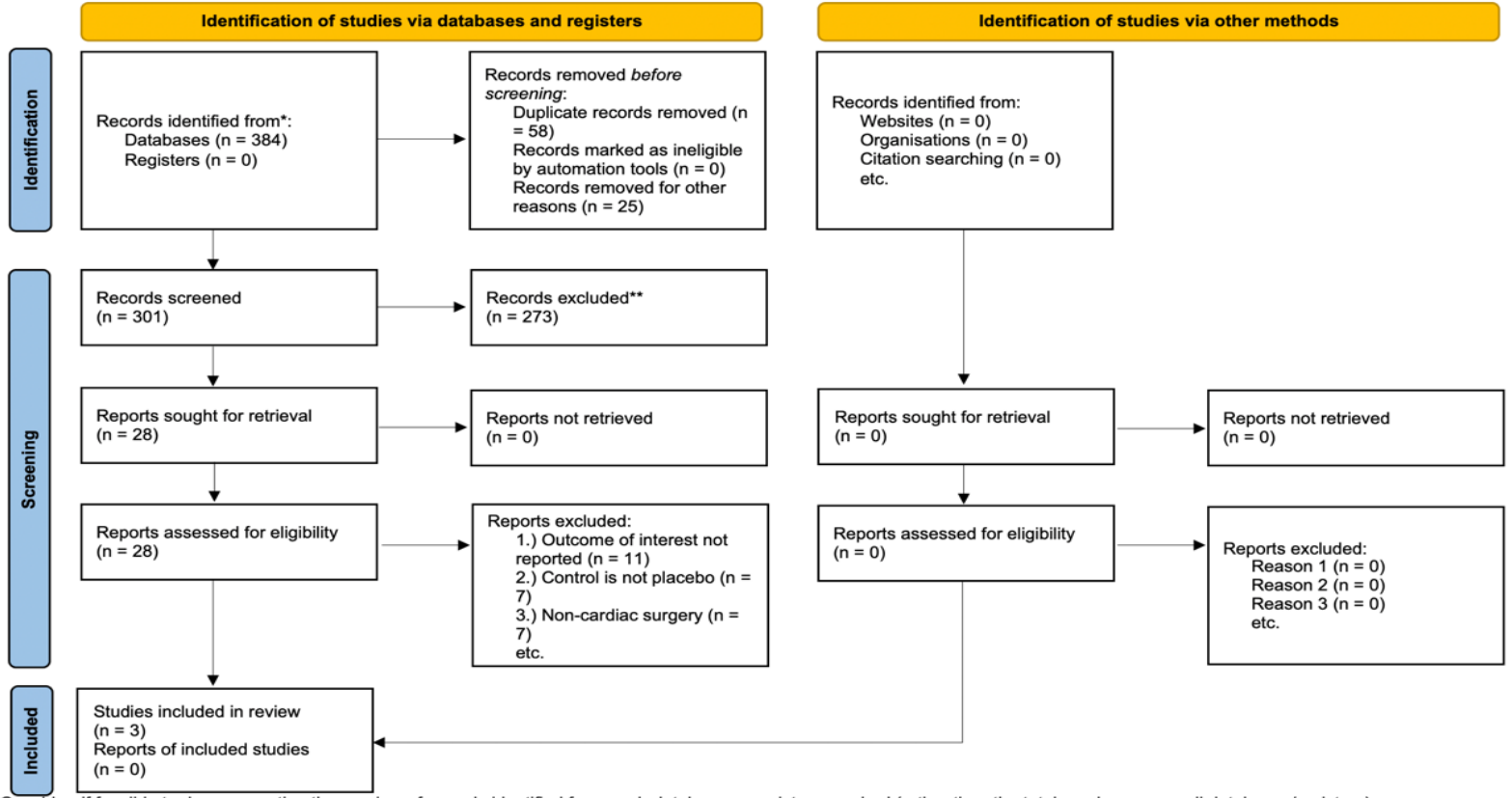
Cross References

Online Search

- PUBMED/MEDLINE
- EMBASE
- Cochrane
- Google Scholar

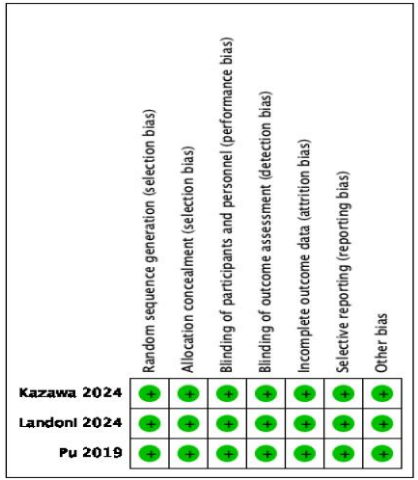
PRISMA (Flow Chart)

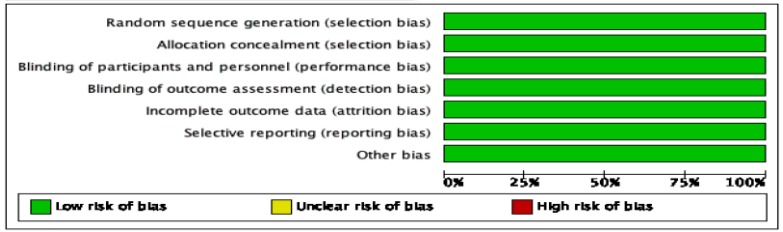
PRISMA 2020 flow diagram for new systematic reviews which included searches of databases, registers and other sources



*Consider, if feasible to do so, reporting the number of records identified from each database or register searched (rather than the total number across all databases/registers).
**If automation tools were used, indicate how many records were excluded by a human and how many were excluded by automation tools.

RISK OF BIAS


Random sequence generation (selection bias)
Allocation concealment (selection bias)
Blinding of participants and personnel (performance bias)
Blinding of outcome assessment (detection bias)
Incomplete outcome data (attrition bias)
Selective reporting (reporting bias)
Other bias
Kazawa 2024
Landoni 2024
Pu 2019


Random sequence generation (selection bias)
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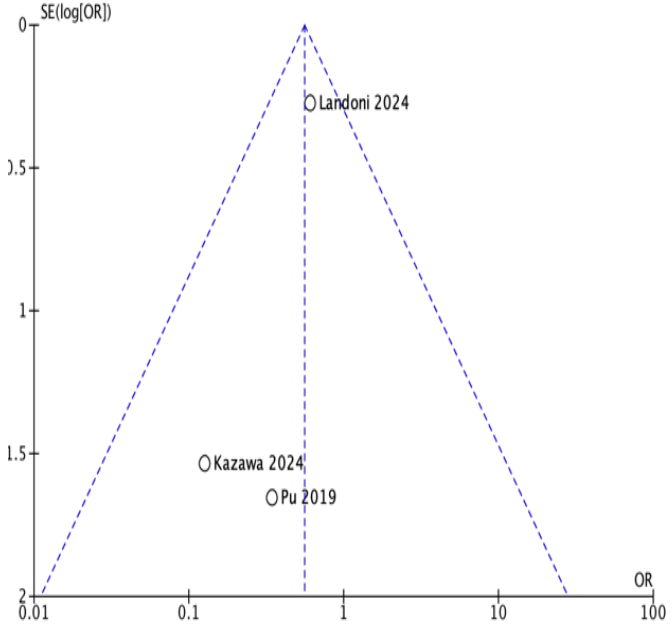
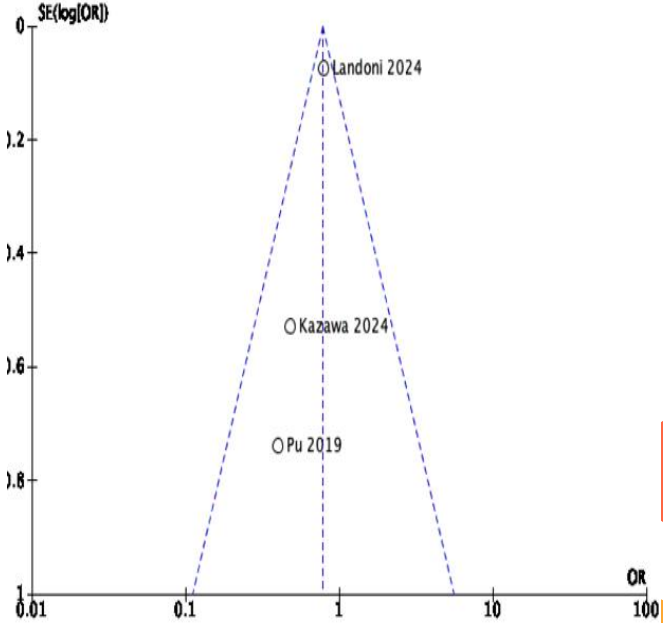
Blinding of participants and personnel (performance bias)
Blinding of outcome assessment (detection bias)
Incomplete outcome data (attrition bias)
Selective reporting (reporting bias)
Other bias
0%
25%
50%
75%
100%
Low risk of bias
Unclear risk of bias
High risk of bias

Risk of Publication Bias





Summary of Studies

Author	Number of Patients	Age (SD)	Control	Intervention	Follow-up of AKI	Type of Surgery	Jadad Composite Scale
Pu (2019)	69	C: 70.8 (9.0) I: 72.3 (9.5)	Standard of Care	L-amino acids 2 gm/kg of IBW (max of 100 g/day) for 3 days (Synthamin 17 Electrolyte Free)	7 days	Cardiac Surgery	5/5
Kazawa (2024)	66	C: 71 (56, 75) I: 72 (52, 77)	Standard of Care	L-amino acids (Amiparen) 60 g/day for 3 days	7 days	Cardiac Surgery	5/5
Landoni (2024)	3511	C: 67 (58, 73) I: 66 (57, 73)	Standard of Care	L-amino acids 2 gm/kg of IBW (max of 100 g/day)	7 days	Cardiac Surgery	5/5

GRADE

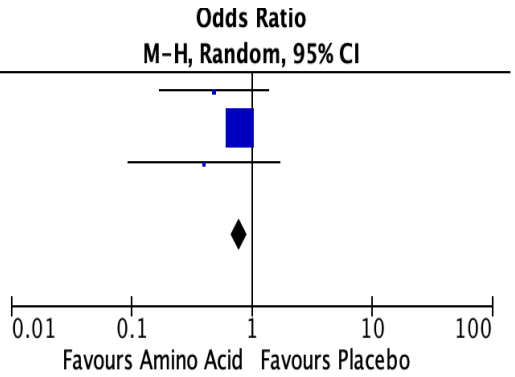
Outcome	Population	Setting	Comparison	Summary of Findings	Effect Estimate (95% CI)	Certainty of Evidence	Justification for rating down certainty
AKI Incidence	Adult patients undergoing cardiac surgery	Perioperative	Amino acid infusion vs. Standard of Care	Amino acid infusion probably reduces AKI risk	OR 0.78, CI: 0.68, 0.90	High	Low Risk of Bias based on the Cochrane Collaboration
Initiation of RRT	Adult patients undergoing cardiac surgery	Perioperative	Amino acid infusion vs. Standard of Care	Amino acid infusion probably reduces AKI risk	OR 0.55, CI: 0.33, 0.93	High	Low Risk of Bias based on the Cochrane Collaboration
30 – Day Mortality	Adult patients undergoing cardiac surgery	Perioperative	Amino acid infusion vs. Standard of Care	Amino acid infusion probably reduces AKI risk	OR 91, CI: 0.63, 1.31	High	Low Risk of Bias based on the Cochrane Collaboration

RESULTS

Study or Subgroup	Amino Acid Events	Amino Acid Total	Placebo Events	Placebo Total	Weight	Odds Ratio M-H, Random, 95% CI
Kazawa 2024	9	33	14	32	1.9%	0.48 [0.17, 1.36]
Landoni 2024	474	1759	555	1752	97.1%	0.80 [0.69, 0.92]
Pu 2019	3	33	7	35	1.0%	0.40 [0.09, 1.70]
Total (95% CI)		**1825**		**1819**	**100.0%**	**0.78 [0.68, 0.90]**
Total events	486		576			

Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 1.71$, df = 2 (P = 0.42); $I^2 = 0\%$

Test for overall effect: Z = 3.35 (P = 0.0008)



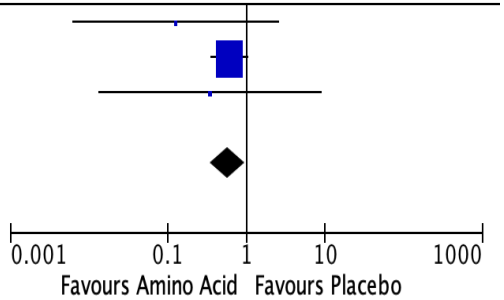
22 % AKI (overall)

RESULTS

Study or Subgroup	Amino Acid Events	Amino Acid Total	Placebo Events	Placebo Total	Weight	Odds Ratio M-H, Random, 95% CI
Kazawa 2024	0	33	3	32	3.0%	0.13 [0.01, 2.54]
Landoni 2024	22	1757	36	1754	94.4%	0.61 [0.35, 1.03]
Pu 2019	0	33	1	35	2.6%	0.34 [0.01, 8.73]
Total (95% CI)		**1823**		**1821**	**100.0%**	**0.57 [0.34, 0.96]**
Total events	22		40			

Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 1.12$, df = 2 (P = 0.57); $I^2 = 0\%$

Test for overall effect: Z = 2.13 (P = 0.03)



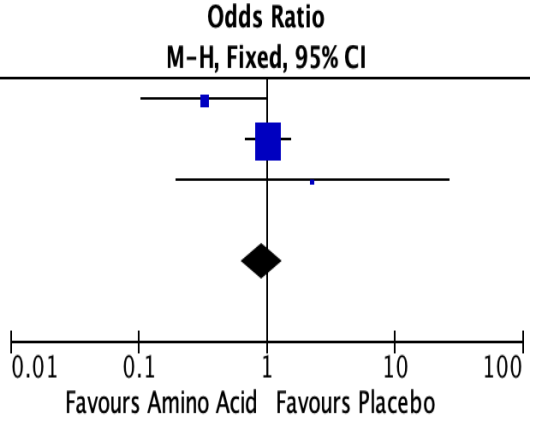
43 % in RRT initiation

RESULTS

Study or Subgroup	Amino Acid Events	Amino Acid Total	Placebo Events	Placebo Total	Weight	Odds Ratio M-H, Fixed, 95% CI
Kazawa 2024	6	33	13	32	18.2%	0.32 [0.10, 1.01]
Landoni 2024	50	1759	49	1752	80.3%	1.02 [0.68, 1.52]
Pu 2019	2	33	1	36	1.5%	2.26 [0.20, 26.13]
Total (95% CI)		**1825**		**1820**	**100.0%**	**0.91 [0.63, 1.31]**
Total events	58		63			

Heterogeneity: $Chi^2 = 4.01$, $df = 2$ ($P = 0.13$); $I^2 = 50\%$

Test for overall effect: $Z = 0.50$ ($P = 0.61$)



The data was not statistically significant

However, there was a trend towards benefit favoring the amino acid group.

DISCUSSION

Direct Effect

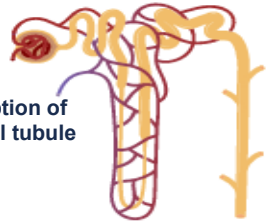
Inhibits Tubuloglomerular Feedback

Afferent arteriolar vasodilation

Release of Nitric Oxide

3.) Activation of Macula Densa

1.) Increased reabsorption of Sodium by the proximal tubule



2.) Decreased delivery of sodium distally

CONCLUSION

Significant reduction in AKI incidence

Decreased need for renal replacement therapy

Potential for improved patient outcomes

PRACTICAL APPLICATION

Moving forward, large-scale trials will be valuable to:

- Validate long-term benefits
- Assess impact on mortality rates
- Evaluate quality of life improvements

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