

Study of Thiamine Supplement Impact on Patients Suffering From Sepsis and Septic Shock

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Abstract

Background: Thiamine and vitamin C have been increasingly used in patients with sepsis or septic shock because of their potential for improving metabolism and reducing mortality. The purpose of this study is to determine if thiamine combined vitamin C can reduce mortality in patients with sepsis or septic shock.

Methods: Patients 18 years of age or older who were admitted to the GMCH, Bettiah, West Champaran, Bihar, Department of Medicine between March 2026 and August 2026 with sepsis or septic shock and received intravenous thiamin in addition to usual care made up the pre-intervention group (n=26). They were paired with a control group of 26 individuals who had the same diagnosis during the retrospective phase. Hospital mortality was the main outcome. Time to death, duration of stay in critical care, time to lactate level <2 mmol/L, vasopressor usage and duration, need for renal replacement therapy (RRT), and PaO₂/FiO₂ ratio were secondary objectives. The development and implementation of an evidence-based thiamin guideline for sepsis standardized the dosage, duration, and time of beginning. The post-intervention thiamin group and the pre-intervention thiamin and control groups were compared in the prospective phase using the same outcomes.

Results: Hospital mortality did not differ between the pre- and post-intervention phases. But compared to the pre-intervention thiamin group, more patients in the control group needed RRT (65.4% vs. 42.3%, P=0.013). In addition, the post-intervention thiamin group required less RRT than the control group (36.8% vs. 65.4%, P=0.02).

Conclusion: There was no benefit to hospital mortality with thiamin. On the other hand, patients with renal failure might be able to use it. Future research should examine thiamine's potential to protect the kidneys.

Keywords: Sepsis; septic shock; thiamine; mortality; renal replacement therapy (RRT).

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Introduction

Because of its roles in the citric acid cycle and pyruvate dehydrogenase complex, thiamin (vitamin B1) is a crucial coenzyme in aerobic energy metabolism. Anaerobic metabolism and severe lactic acidosis result from pyruvate's inability to enter the tricarboxylic acid cycle due to insufficient thiamin. [1,2]. Between 20% and 70% of critically ill individuals have a thiamin deficit [3,4,5,6]. In septic patients, thiamin deficiency can exacerbate shock and organ failure by interfering with aerobic metabolism, which results in decreased vascular

tone, increased lactate levels, and impaired ATP production. [6]. Accordingly, intravenous thiamine supplementation has been proposed as a potential treatment to improve outcomes in patients with septic shock. However, the therapeutic efficacy of thiamine in septic shock remained unclear. Evidence supporting thiamine therapy in septic shock remains inconsistent. Some studies report improved lactate clearance or reduced vasopressor requirements, while others show no benefit in mortality or hemodynamic outcomes. Regional

data, including from, is scarce. Therefore, this study evaluated whether intravenous thiamine is associated with improved mortality, shock resolution, or hemodynamic recovery in septic shock, and explored factors that may influence patient response.

Material and Methods

This study was done at Medicine department of GMCH, Bettiah, West Champaran, and Bihar from March 2026 to August 2026. Total 52 Patients aged >18 years with sepsis/septic shock were included in this study.

In the pre-intervention phase, critical care patients with sepsis or septic shock diagnosis, who did not receive thiamine, were matched with patients who received average daily thiamine dose of 200 mg for the period of January 1st through July 15th, 2023.

Twenty-six patients in the control group were matched with 26 patients who received any dose of IV thiamine, with a total of 52 patients in the retrospective phase, based on receiving standard of care (IV fluids and antibiotics within three hours of diagnosis) and ventilation. The post-intervention phase patients received 200 mg of thiamine intravenously every 12 hours within six hours of sepsis or septic shock diagnosis for a minimum of 72 hours or six doses.

The primary endpoint was hospital mortality. The secondary endpoints were time to death, time to lactate level less than 2 mmol/L, vasopressor use, ICU length of stay, vasopressor duration, renal

replacement therapy (RRT) requirement, PaO₂/FiO₂ ratio at discharge, as well as SOFA score at 72 hours. The inclusion criteria were: age of 18 years or older, critical care unit admission with sepsis or septic shock diagnosis. The exclusion criteria were: allergy or anaphylactic reaction to thiamine, clinical indication for thiamine (e.g., alcoholism, Wernicke's encephalopathy), and pregnancy.

Statistical tests for data analysis included chi-square and Fisher's Exact (when 50% of the values had expected counts less than five for categorical data). Continuous data were analyzed using Wilcoxon Rank Sum test and presented using median and interquartile range. Alpha level for statistical significance was set at 0.05 or less. Time to event analysis was presented as Kaplan-Meier survival curves for time to hospital mortality and time to discharge from critical care unit.

Results

52 patients who fulfilled the eligibility criteria were chosen at random from the 345 individuals who were screened for the study's retrospective phase. The thiamin (n = 26) and control groups (n = 26) had comparable baseline characteristics for the retrospective pre-intervention period, with the exception of gender, vasopressor use, baseline AKI, and antibiotic commencement within three hours of sepsis diagnosis (Table 1). Steroid use was another distinction between the groups' baseline characteristics: almost 70% of the thiamin group and 50% of the control group got steroids.

Table 1: Baseline characteristics in control versus pre-intervention thiamine group

Variable	Control group (n=26)	Pre-intervention thiamine group (n=26)	P value
Age, mean±SD, years	65.7±3.3	62.6±12.9	0.386
Weight, mean±SD, kg	84.7±31.5	80.6±18.9	0.400
Sex, male, n(%)	22 (84.6)	16 (61.5)	0.007
Admission diagnosis, n(%)			
Community acquired pneumonia	8(30.8)	6(23.1)	0.395
Pneumonia due to COVID	9(34.6)	11 (42.3)	0.410
Surgical site infection	0(0)	1(3.85)	0.845
UTI/pyelonephritis	4(15.4)	3(11.5)	0.587
GI infection	2(7.7)	2(7.7)	1.0
HCAP	0(0)	1(3.8)	0.845
Respiratory distress	0(0)	2(7.7)	0.695
SSTI	3(11.5)	1(3.8)	0.220
Unknown	0(0)	1(3.8)	0.845
Comorbidities, n(%)			
CAD/MI	6(23.1)	8(30.8)	0.3352
Hypertension	14 (65.4)	15(57.7)	0.410
Hyperlipidemia	7(26.9)	11 (42.3)	0.077
Diabetes	9(34.6)	10 (38.5)	0.680
Heart failure	2(7.7)	3(11.5)	0.462
CVA	3(11.5)	1(3.85)	0.220
COPD	3(11.5)	2(7.7)	0.539

CKD	2(7.7)	2(7.7)	1.0
PVD	0(0)	1(3.85)	0.845
Immunocompromised	5(19.2)	4(15.4)	0.619
Cirrhosis	0(0)	1(3.85)	0.845
Opioid use	3(11.5)	1(3.85)	0.220
None/unknown	3(11.5)	4(15.4)	0.539
Mechanical ventilation	18 (69.2)	21 (80.8)	0.202
Vasopressors	14 (53.8)	24 (92.3)	0.004
Positive blood cultures	17 (65.4)	16 (61.5)	0.680
Acute kidney injury	11 (42.3)	22 (84.6)	0.005
Laboratory values			
Lactate, median(IQR), mmol/L	2.7(1.3–4.2)	2.2(1.5–5.7)	0.543
Procalcitonin, median (IQR), mcg/mL	0.51(0.19–1.94)	0.81(0.19–5.00)	0.488
PaO ₂ /FiO ₂ ratio, mean±SD, mmHg	212.7778±123.5588	195.3444±142.7044	0.445
Treatment timing and duration			
Fluids within 3 hours of sepsis diagnosis, n(%)	21 (80.8)	18 (69.2)	0.135
Antibiotics within 3 hours of sepsis diagnosis, n(%)	24 (92.3)	15 (57.7)	<0.0001
Timing of thiamine initiation, mean±SD, h	–	155.2±183	–
Number of thiamine doses, mean±SD	–	8.8±5.7	–
Thiamine dose, mean±SD, mg	–	220±110	–
Receipt of steroid, n(%)	13 (50.0)	18 (69.2)	0.049
Daily steroid dose (hydrocortisone equivalent), median (IQR), mg	200[200–530]	200[100–300]	0.330
Duration of steroid therapy, median (IQR), h	96 [38–240]	72 [24–144]	0.290
COVID presence at diagnosis, n(%)	11 (42.3)	12 (46.2)	0.691

Regarding the main outcome, there was no statistically significant difference between the two groups. With the exception of RRT requirements, which were higher in the control group than in the treatment group (65.4% vs. 42.3%, $P=0.013$) (Table 2), there was no difference between the groups' secondary outcomes.

Table 2: Outcomes in control versus pre-intervention thiamine group

Primary outcome	Control group (n=26)	Pre-intervention thiamine group (n=26)	P value
Hospital mortality, n(%)	9(34.6)	10 (38.5)	0.680
Secondary outcomes			
Time to death, median (IQR), days	9[8–21]	7.5[3–12]	0.93
Time to lactate levels <2mmol/L, median (IQR), hours	21 [10–24]	37.5[24–48]	0.06
ICU/IMCU length of stay, median(IQR), days	9(4–17.3)	11.5(6.8–25.3)	0.479
Vasopressor duration, median (IQR), h	48 (23.5–117.8)	51.5[24–151]	0.75
RRT required, n(%)	17 (65.4)	11 (42.3)	0.013
PaO ₂ /FiO ₂ ratio, median (IQR), mmHg	244[127–305]	197[107–327]	0.59

The pre-intervention and post-intervention thiamine groups' primary and secondary outcomes were contrasted. The timing of antibiotic initiation was the only difference between the two groups' baseline characteristics. Patients in the

retrospective thiamine group were less likely than those in the post-intervention thiamine group to receive antibiotics within three hours of being diagnosed with sepsis or septic shock (57.7% vs. 92.1%, $P=0.001$) (Table 3).

Table 3: Baseline characteristics in prospective phase: pre-intervention vs. post-intervention thiamine groups

Variable	Pre-intervention thiamine group (n=26)	Post-intervention thiamine group (n=26)	P value
Age, mean±SD, years	62.6±12.9	67.3±12.9	0.11
Weight, mean±SD, kg	80.6±18.9	81.1±23.9	0.85
Sex, male, n(%)	16 (61.5)	27 (71.1)	0.63
Admission diagnosis, n(%)			
Septic shock due to pneumonia	17 (65.4)	17 (44.7)	0.05
Septic shock due to UTI	3(11.5)	3(3.79)	0.68
GI infection	2(7.7)	1(2.6)	0.99
SSTI	1(3.8)	1(2.6)	0.99

Comorbidities, n(%)			
CAD/MI	8(30.8)	5(13.2)	0.09
Hypertension	15 (57.7)	24 (63.2)	0.66
Hyperlipidemia	11 (42.3)	18 (47.4)	0.69
Diabetes	10 (38.5)	15 (39.5)	0.94
Heart failure	3(11.5)	6(15.8)	0.73
COPD	2(7.7)	3(7.9)	0.98
CKD	2(7.7)	6(15.8)	0.46
Immunocompromised	4(15.4)	5(13.2)	0.80
None/unknown	4(15.4)	4(10.5)	0.71
Other, n(%)			
Mechanical ventilation	21 (80.8)	34 (89.5)	0.29
Vasopressors	24 (92.3)	38 (100)	0.16
Positive blood cultures	16 (61.5)	20 (52.6)	0.48
Acute kidney injury	22 (84.6)	26 (68.4)	0.27
Laboratory values			
Lactate, median(IQR), mmol/L	2.2(1.5–5.7)	3.7(2.2–8.3)	0.06
PaO ₂ /FiO ₂ ratio, mean±SD, mmHg	195.3±142.7	134.5±80.3	0.20
SOFA score on day1, median (IQR)	7(4.7–9.5)	9(7.8–9)	0.22
Treatment timing and duration			
Fluids within 3 hours of sepsis diagnosis, n(%)	18 (69.2)	29 (76.3)	0.53
Antibiotics within 3 hours of sepsis diagnosis, n(%)	15 (57.7)	35 (92.1)	0.001
Number of thiamine doses, mean±SD	8.8±5.7	10±6.9	0.31
Daily thiamine dose, mean±SD, mg	220±110	400±0	–
Received steroids, n(%)	18 (69.2)	32 (84.2)	0.15
Daily steroid dose (hydrocortisone equivalent), median (IQR), mg	200[100–300]	200[200–200]	0.80
Duration of steroid therapy, median (IQR),h	72 [24–144]	99 [72–192]	0.10
COVID presence at diagnosis, n(%)	12 (46.2)	18 (71.1)	0.92

The post-intervention thiamin group with standardized thiamin dose did not show any mortality benefit throughout the prospective period (Table 4). Furthermore, there was no discernible difference in secondary outcomes between the thiamin groups before and after the intervention.

Table 4: Outcomes in prospective phase: pre-intervention vs. post-intervention thiamine groups

Primary outcome	Pre-intervention thiamine group (n=26)	Post-intervention thiamine group (n=26)	P value
Hospital mortality, n(%)	10 (38.5)	23 (60.5)	0.08
Secondary outcomes			
Time to death, median (IQR), days	7.5[3–12]	11.5[7–21]	0.26
Time to lactate levels<2mmol/L, median (IQR), hours	37.5[24–48]	28 [18–86]	0.47
ICU/IMCU length of stay, median (IQR), days	11.5(6.8–25.3)	13 [8–19]	0.86
Vasopressor duration, median (IQR),h	51.5[24–151]	79.8[34–203]	0.29
RRT required, n(%)	11 (42.3)	14 (36.8)	0.66
PaO ₂ /FiO ₂ ratio,median (IQR), mmHg	197[107–327]	178[93–250]	0.77
SOFA score at 72 hours	8(6.5–12)	8(4.8–12)	0.90

There were some baseline differences between the post-intervention thiamin group (n = 26) and the control group (n = 26). It is noteworthy that all patients in the post-intervention thiamin group had lower PaO₂/FiO₂ ratios, greater lactate levels,

higher SOFA scores, and the need for vasopressors at baseline (Table 5). Hospital mortality was the main outcome that differed between the two groups (34.6% vs. 60.5% control vs. post-intervention thiamin groups, respectively; P=0.04) (Table 6).

Table 5: Baseline characteristics in prospective phase: control vs. post-intervention thiamine group

Variable	Control (n=26)	Post-intervention thiamine group (n=38)	P value
Age, mean±SD, years	65.7±16.8	67.3±12.9	0.58
Weight, mean±SD, kg	84.7±31.5	81.1±23.9	0.87
Sex, male, n(%)	22 (84.6)	27 (71.1)	0.21
Admission diagnosis, n(%)			
Septic shock due to pneumonia	9(34.6)	17 (44.7)	0.42
Septic shock due to UTI	4(15.4)	3(7.9)	0.43
GI infection	2(7.7)	1(2.6)	0.56
SSTI	3(11.5)	1(2.6)	0.30
Comorbidities, n(%)			
CAD/MI	6(23.1)	5(13.2)	0.30
Hypertension	14 (53.8)	24 (63.2)	0.46
Hyperlipidemia	7(26.9)	18 (47.4)	0.10
Diabetes	9(34.6)	15 (39.5)	0.69
Heart failure	2(7.7)	6(15.8)	0.34
COPD	3(11.5)	3(7.9)	0.62
CKD	2(7.7)	6(15.8)	0.34
Immunocompromised	5(19.2)	5(13.2)	0.51
None/unknown	3(11.5)	4(10.5)	0.90
Other, n(%)			
Mechanical ventilation	18 (69.2)	34 (89.5)	0.05
Vasopressors	16 (61.5)	38 (100)	<.0001
Positive blood cultures	17 (65.4)	20 (52.6)	0.31
Acute kidney injury	11 (42.3)	26 (68.4)	0.04
Laboratory values			
Lactate, median(IQR), mmol/L	2.7(1.3–4.1)	3.7(2.2–8.2)	0.01
PaO ₂ /FiO ₂ ratio, mean±SD, mmHg	212.3±123.6	134.5±80.3	0.02
SOFA score on day1, median (IQR)	6.5[4–8]	9[7–10]	0.045
Treatment timing and duration			
Fluids within 3 hours of sepsis diagnosis, n(%)	21 (80.8)	29 (76.3)	0.67
Antibiotics within 3 hours of sepsis diagnosis, n(%)	24 (92.3)	35 (92.1)	0.98
Number of thiamine doses, mean±SD	–	10±6.9	–
Daily thiamine dose, mean±SD, mg	–	400±0	–
Received steroids, n(%)	13 (50.0)	32 (84.2)	0.003
Daily steroid dose (hydrocortisone equivalent), median (IQR), mg	200[200–530]	200[200–200]	0.06
Duration of steroid therapy, median (IQR),h	96 [38–240]	99 [72–192]	0.53
COVID presence at diagnosis, n(%)	11 (42.3)	18 (71.1)	0.69

Table 6: Outcomes in prospective phase: control vs. post-intervention thiamine group

Primary outcomes	Control (n=26)	Post-intervention thiamine group(n=38)	P value
Hospital mortality, n(%)	9(34.6)	23 (60.5)	0.04
Secondary outcomes			
Time to death, median (IQR), days	9[8–21]	13 [8–19]	0.83
Time to lactate levels<2mmol/L, median(IQR), hours	18 [10–24]	28 [18–84]	0.08
ICU/IMCU length of stay, median (IQR), days	9[4–16]	11.5[7–21]	0.28
Vasopressor duration, median (IQR),h	47.5(23.0–94.5)	79.8(37.0–194.5)	0.18
RRT required, n(%)	17 (65.4)	14 (36.8)	0.02
PaO ₂ /FiO ₂ ratio, median (IQR), mmHg	244[127–305]	178.6(95.9–334.0)	0.41
SOFA score at 72 hours, median (IQR)	7[6–9]	8[7–10]	0.41

Discussion

During the retrospective phase, more patients in the control group than in the thiamin group were started on antibiotics promptly. Although this is a

complicating factor, the degree to which it influences the frequency of the main result in each group is uncertain. The small sample size and variations in several baseline features in the pre-

intervention group restrict how broadly the study's findings can be applied.

Because patients who survived were more likely to remain in the intensive care unit before being discharged or reduced, the thiamin group also had a longer time to discharge in the retrospective phase. There was no variation in baseline characteristics between the pre-intervention and post-intervention thiamin groups during the post-intervention period, with the exception of the post-intervention thiamin group starting antibiotics earlier. Several important baseline variables, including the number of patients on vasopressors, baseline lactate levels, SOFA score, and PaO₂/FiO₂ ratios, showed significant differences between the retrospective control group and the post-intervention thiamin group. As the post-intervention thiamine group had sicker patients with higher lactate levels, higher SOFA scores, and lower PaO₂/FiO₂ ratio, this can help explain the lack of mortality benefit in the intervention group.

With the exception of RRT need, the thiamin groups in the current study's retrospective or pre-intervention phase did not outperform the control group in terms of primary or the majority of secondary outcomes. This suggests that thiamin medication may be beneficial for critically unwell patients by protecting their kidneys. However, the latter finding is merely exploratory in nature, and the RRT need was a secondary outcome of the study's retrospective phase. This study's results are consistent with those of a double-blind, randomized trial where thiamin decreased the need for RRT.[10]

The study found no statistically significant differences between standardized and nonspecific thiamin dose techniques either the prospective or post-intervention period. Given the risk vs. benefit profile, thiamin may be taken into consideration despite the fact that this trial was unable to show a mortality impact. The difference between no thiamin and thiamin at evidence-based doses may have been lessened if any thiamin had been administered, masking the effect of guideline-based thiamin.

The applicability of study results is limited by study limitations, such as a small sample size and differing baseline characteristics for some variables. Notably, patients in the post-intervention thiamin group were sicker, which may have contributed to the earlier use of antibiotics.

This benefit might have outweighed the advantages of a consistent thiamin dosing strategy because it is one of the key elements that drives mortality reduction. It is a significant confounding factor that this study was unable to sufficiently account for. Even a marginal benefit of thiamine in this patient

population can make a difference in mortality with a properly conducted large-scale study. Although there is currently little data to support its usage, thiamin, either with or without IV steroids and vitamin C, may be a potential treatment for sepsis or septic shock. Thiamine's impact on the pentose phosphate pathway, which facilitates the metabolism of carbohydrates and converts anaerobic cellular metabolism to aerobic metabolism, provides justification for its use in this patient population.[7-9]

Conclusion

Future studies should look more closely at how thiamin affects hospital mortality in septic patients when used in conjunction with other treatments like vitamin C and IV steroids. Thiamin advantages may also be investigated in septic individuals with renal impairment.

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