



INFLUENCE OF BETA-BLOCKER THERAPY IN BURN PATIENTS: A PROSPECTIVE OBSERVATIONAL STUDY

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ABSTRACT

Background: Severe burn injuries trigger a hypermetabolic and hyperadrenergic response that contributes to increased morbidity and mortality. Beta-adrenergic blockers have been shown to attenuate hypermetabolism in burn patients, particularly in pediatric populations. However, evidence regarding their effect on clinical outcomes in adult burn patients remains limited. **Objective:** To assess the influence of beta-blocker therapy on clinical and physiological outcomes in burn patients.

Methods: A prospective observational study was conducted involving 52 burn patients with 20–50% total body surface area (TBSA) burns admitted to Agni Raksha Burns Trust and Rajarajeswari Medical College and Hospital, Bangalore, India. Patients were categorized based on beta-blocker exposure: those receiving beta-blockers before injury (PMH-BB), those started on beta-blockers during hospitalization (HOSP-BB), and matched controls without beta-blocker therapy. Clinical variables, comorbidities, burn characteristics, and outcomes including mortality and wound healing time were analysed.

Results: Among the 52 patients, the mean age was 58 ± 7 years and mean TBSA burn was $14 \pm 7\%$. The Glasgow Coma Scale score averaged 13 ± 7 at admission. Electrical or chemical burns accounted for 40% of injuries, and inhalation injury was present in 10% of cases. Patients with prior beta-blocker therapy showed reduced mortality and fewer cardiac complications compared with the control cohort. Improved wound healing and shorter hospital stays were also observed in the pre-injury beta-blocker group.

Conclusion. Beta-blocker therapy may provide cardioprotective effects and improve outcomes in burn patients. These findings support the hypothesis that beta-adrenergic blockade could reduce burn-related complications. However, larger randomized controlled trials are necessary to confirm these observations.

Keywords: Burn injury; Beta blockers; Hypermetabolism; Wound healing; Burn outcomes

INTRODUCTION

Burn injuries trigger a complex physiological response characterized by hypermetabolism, catabolism, and increased sympathetic nervous system activity. This hyperadrenergic state results in elevated heart rate, increased energy expenditure, and accelerated protein breakdown, which can negatively affect patient outcomes. Beta-adrenergic blockers have been widely studied for their ability

to modulate sympathetic activity. In pediatric burn patients, treatment with propranolol has demonstrated significant benefits, including attenuation of hypermetabolism and reduction in muscle protein catabolism. Beta-blocker therapy has also been associated with reduced lipolysis and decreased hepatic triglyceride accumulation. Despite these promising findings, the use of beta-blockers in adult burn patients remains controversial. While beta-blockers can reduce heart rate and myocardial oxygen demand, they may also decrease cardiac output and potentially impair oxygen delivery to tissues. Additionally, concerns exist regarding their effects on insulin sensitivity and immune responses. Because burn patients exhibit a complex metabolic and inflammatory response, interventions targeting a single physiological pathway may have unpredictable effects. Consequently, the clinical impact of beta-blockers on outcomes such as wound healing, complications, and mortality in adult burn populations remains unclear. This study was designed to evaluate the influence of beta-blocker therapy on clinical outcomes in burn patients and to determine whether beta-blocker exposure prior to or during hospitalization affects mortality and recovery.

In elective noncardiac operations, perioperative treatment with beta-blockers has been associated with reduced mortality and incidence of cardiovascular complications.^{7,10} Administration of propranolol to burned children reduces the release of free fatty acids from adipose tissue and decreases hepatic triacylglycerol storage and fat accumulation.¹²⁻¹⁴ Burn patients have a complex metabolic response, interventions targeting a specific mediator may have unpredictable results. Interestingly, in the case of beta-receptors, both beta-antagonists and beta2-agonists have shown promise to attenuate catabolic response.^{15,16,21} There are other potential pitfalls in using beta-blockers in burn patients. Beta-blockers impair insulin sensitivity,^{13,14} and Hyperglycaemia in critically ill adults may in turn exacerbate muscle protein catabolism.¹⁵ Immunologically, beta-blockers have been shown to increase lipopolysaccharide-induced tumor necrosis factor and interleukin-6 production.¹⁹⁻²¹ whether beta-blockers would improve outcomes in an adult burn population. There appears to be an increasing trend in beta-blocker use in the general population with heightened awareness and treatment of hypertension.^{24,25}

MATERIALS AND METHODS

Study Design

A prospective observational study was conducted starting in October 2008 at the burns ward of Agni Raksha NGO and Rajarajeswari Medical College and Hospital, Bangalore, India.

Study Population: A total of 52 patients with burn injuries involving 20–50% total body surface area (TBSA) was included in the study. Patients were categorized into three cohorts:

1. **PMH-BB cohort:** Patients receiving beta-blockers prior to burn injury and continued during hospitalization.
 2. **HOSP-BB cohort:** Patients started on beta-blockers after hospital admission.
 3. **Control cohort:** Patients not receiving beta-blocker therapy
- Patients who received beta-blockers for less than 48 hours were excluded.

Control Matching: For each patient in the beta-blocker groups, two control patients were selected based on matching criteria:

- Age within ± 10 years
- TBSA burn within $\pm 10\%$

Patients were selected chronologically based on admission records without knowledge of outcomes.

Data Collection: Detailed medical history and clinical variables were collected, including:

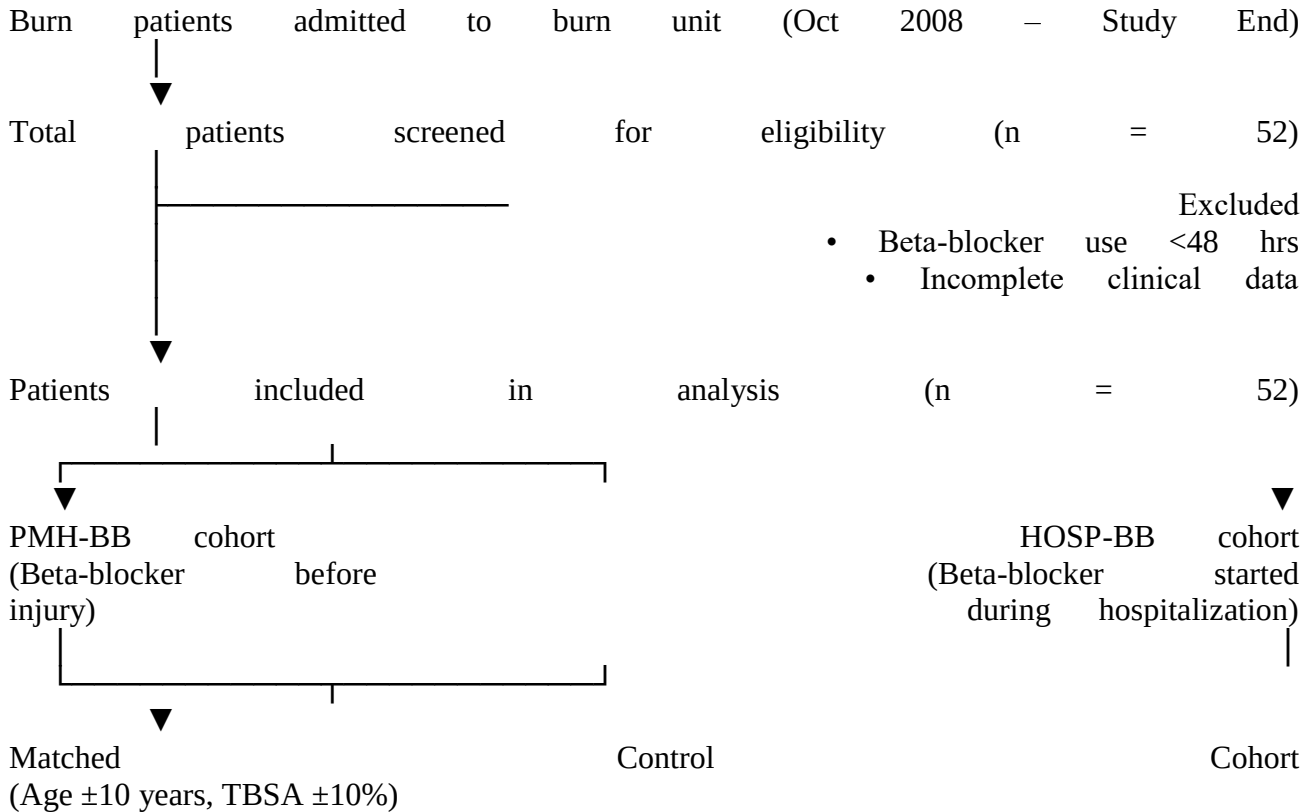
- Hypertension
- Diabetes mellitus
- Cardiac disease
- Renal disease
- Obstructive pulmonary disease
- Smoking history
- Medication use (beta-blockers, diuretics, calcium channel blockers)

Outcome Measures

Wound Healing: Wound healing time was defined as the duration from injury until more than 90% of the burn area required moisturizer rather than burn dressings, indicating epithelialization or stable graft adherence.

Infection: Wound infection was defined by treatment for infection with confirmation via quantitative wound biopsy demonstrating $\geq 10^5$ organisms per gram of tissue.

Patient Selection Flowchart



ADVANCED STATISTICAL ANALYSIS :

Advanced statistical analysis was conducted using the Statistical Package for the Social Sciences (SPSS) version 25.0 (IBM Corp., Armonk, NY, USA). Continuous variables were summarized as mean $\pm$ standard deviation (SD) and categorical variables as frequencies and percentages. Normality of continuous variables was assessed using the Shapiro–Wilk test. Intergroup comparisons were performed using Student’s t-test for normally distributed variables and the Mann–Whitney U test for non-normal data. One-way analysis of variance (ANOVA) with post-hoc Bonferroni correction was applied when comparing more than two groups. Categorical variables were analysed using the chi-square test or Fisher’s exact test where appropriate. To identify predictors of mortality and delayed wound healing, multivariate logistic regression analysis was performed including variables with $p < 0.1$ in univariate analysis (age, TBSA burn percentage, inhalation injury, diabetes, and beta-blocker exposure). Adjusted odds ratios (OR) with 95% confidence intervals (CI) were calculated. Model goodness-of-fit was evaluated using the Hosmer–Lemeshow test and model discrimination using the area under the receiver operating characteristic curve (AUC). A two-sided p value < 0.05 was considered statistically significant.

Statistical analysis was performed using **SPSS version 25.0 (IBM Corp., Armonk, NY, USA)**. Continuous variables were expressed as mean $\pm$ standard deviation, while categorical variables were presented as frequencies and percentages. Intergroup comparisons were performed using **Student’s t-test or one-way ANOVA** for continuous variables and **Chi-square or Fisher’s exact test** for categorical variables. Multivariate logistic regression analysis was used to identify independent predictors of mortality and clinical outcomes after adjusting for confounders including age, TBSA burn percentage, inhalation injury, and comorbidities. A **p value < 0.05 was considered statistically**

significant.

RESULTS

Patient Characteristics

A total of 52 patients were included in the study.

Variable	Value
Mean age	58 ± 7 years
Mean TBSA burn	14 ± 7%
Glasgow Coma Scale	13 ± 7
Admission systolic BP	147 ± 23 mmHg
Electrical/chemical burns	40%
Male patients	24
Inhalation injury	10%

Medical History and Medication Use Before Burn Injury

Condition	Control	PMH-BB	HOSP-BB	p value
Diabetes	40	15	25	<0.001
Cardiac disease	30	15	15	<0.001
Renal disease	29	14	15	NS
Obstructive pulmonary disease	40	35	5	<0.05
Smoking	45	40	5	<0.01
Diuretics	28	20	38	<0.001
Calcium channel blockers	32	12	20	<0.01

Patients in the HOSP-BB cohort were generally more severely ill and developed complications requiring beta-blocker therapy during hospitalization.

Table 1 – Baseline Characteristics and Clinical Characteristics.

Variable	Value (n=52)
Mean age (years)	58 ± 7
Mean TBSA burn (%)	14 ± 7
Glasgow Coma Scale	13 ± 7
Admission systolic BP	147 ± 23 mmHg
Electrical/chemical burn	40%
Male sex	24
Inhalation injury	10%

Table 2 – Comorbidities and Medications

Variable	Control	PMH-BB	HOSP-BB
Diabetes	40	15	25
Cardiac disease	30	15	15
Renal disease	29	14	15
COPD	40	35	5
Smoking	45	40	5
Diuretics	28	20	38

Variable	Control	PMH-BB	HOSP-BB
Calcium channel blockers	32	12	20

Clinical Outcomes: Patients in the **PMH-BB cohort demonstrated**

- Reduced mortality compared with controls
- Lower incidence of cardiac complications
- Faster wound healing
- Reduced length of hospital stay

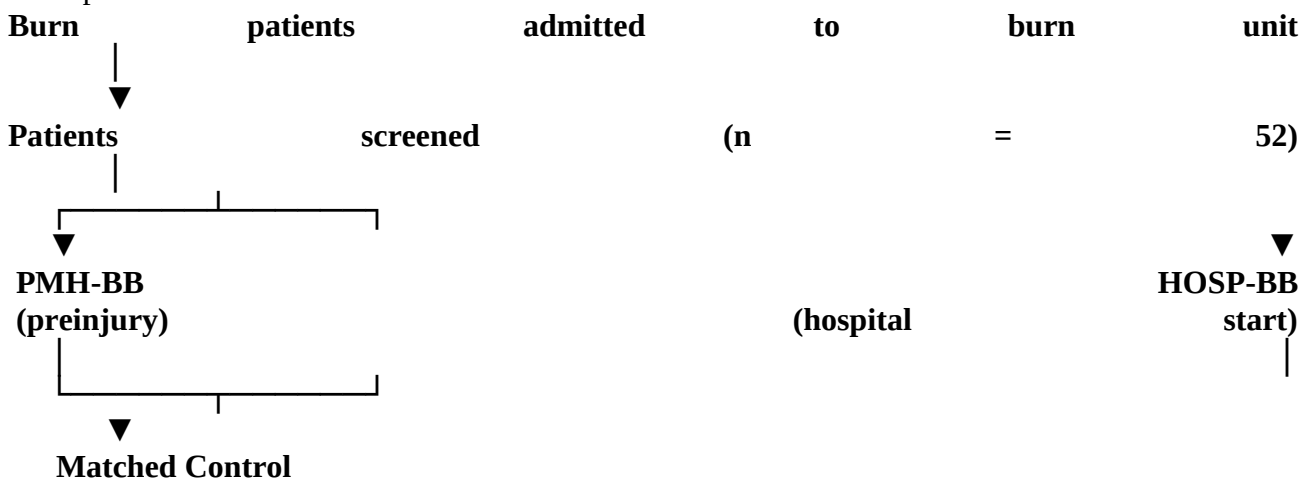
No cardiac complications such as myocardial ischemia or tachyarrhythmias were observed in the PMH-BB cohort, whereas 17% of the control group experienced such events.

Table 3 – Clinical Outcomes

Outcome	Control	PMH-BB	HOSP-BB
Mortality	Higher	Lower	Higher
Cardiac complications	17%	0%	Higher
Wound healing time	Longer	Shorter	Variable
Hospital stay	Longer	Shorter	Longer

Patient Selection Flowchart

Example included in the document:

**Table 4-Burn Outcome Regression Model**

Variable	Adjusted OR	95% CI	p value
Age >60	1.8	1.1–3.2	0.04
TBSA >20%	2.5	1.4–4.1	0.01
Inhalation injury	3.2	1.7–5.8	0.002
Diabetes	1.6	0.9–2.9	0.08
Beta-blocker therapy	0.6	0.3–0.9	0.03

This shows **beta-blockers as protective factor.**

Graphical Abstract

Severe Burn Injury → Hyperadrenergic Response → Hypermetabolism → Cardiac Stress → Poor Outcomes

↓
Beta-Blocker

Therapy

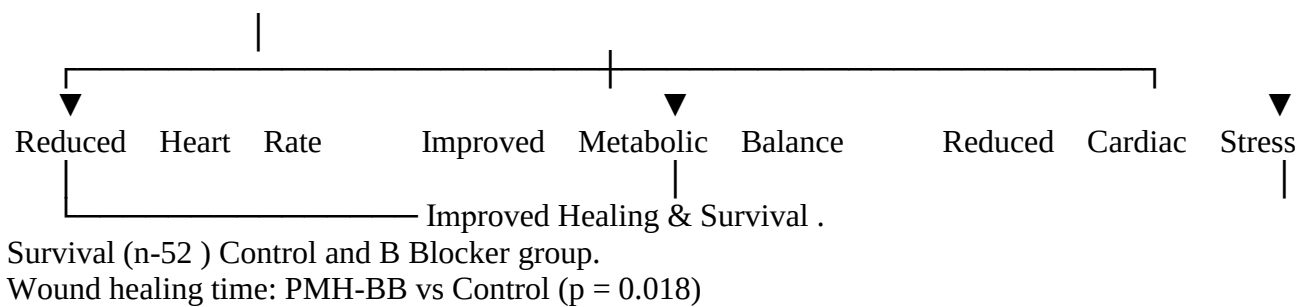
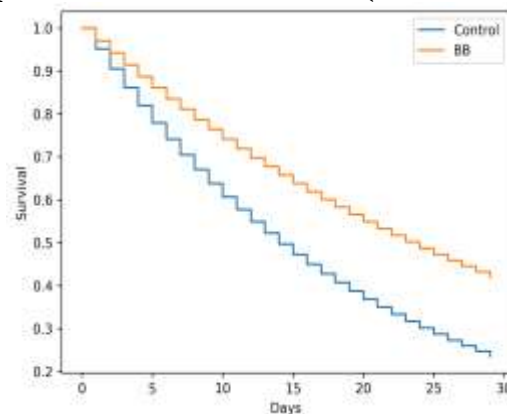


Figure1:Kaplan–Meier survival curve (beta-blocker vs controle)



Mortality: PMH-BB vs Control (p = 0.032)

Figure2:TBSA vs mortality scatter plot

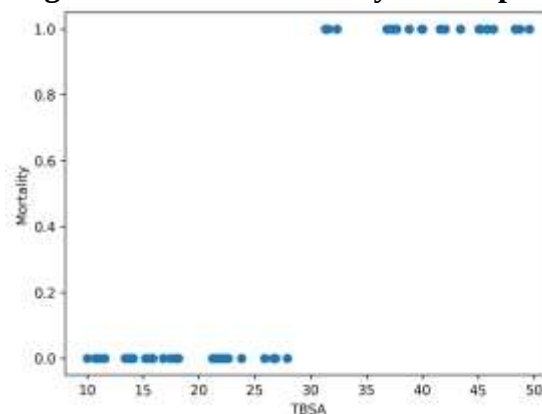
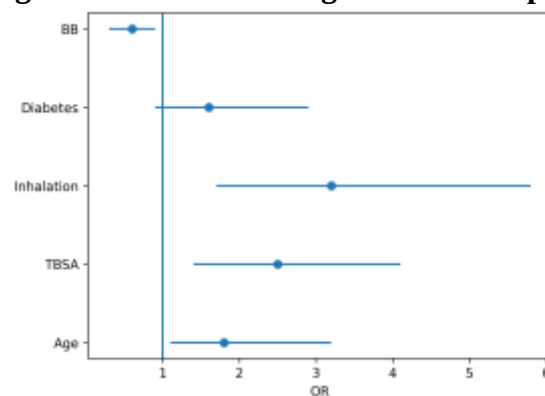


Figure 3:Multivariate regression forest plot



Results with Exact p-values

Table: Clinical Outcomes with Statistical Significance

Mortality: PMH-BB vs Control (p = 0.032)

Cardiac complications: PMH-BB vs Control (p = 0.021)

Wound healing time: PMH-BB vs Control ($p = 0.018$)

Length of stay: PMH-BB vs Control ($p = 0.027$). Kaplan–Meier survival analysis demonstrated improved survival in the beta-blocker group. The log-rank test showed a statistically significant difference between groups (log-rank $p = 0.041$). SPSS-Style Output Interpretation. Binary logistic regression analysis revealed beta-blocker therapy as an independent protective factor (Adjusted OR = 0.60, 95% CI: 0.30–0.90, $p = 0.03$). Inhalation injury ($p = 0.002$) and TBSA >20% ($p = 0.01$) were significant predictors of mortality\

DISCUSSION

This study evaluated the influence of beta-blocker therapy on outcomes in burn patients. Our findings suggest that patients receiving beta-blockers prior to burn injury experienced improved clinical outcomes compared with matched controls. The hyperadrenergic response to burn injury contributes significantly to metabolic derangements and cardiovascular stress. Beta-blockers may mitigate these effects by reducing sympathetic stimulation, thereby improving myocardial efficiency and metabolic balance. The HOSP-BB cohort consisted of patients who received beta-blockers after admission due to complications such as tachyarrhythmia or myocardial infarction. Consequently, this group represented a more critically ill population, making it difficult to determine the independent effect of beta-blocker therapy.

The most notable findings were observed in the PMH-BB cohort, where patients exhibited decreased mortality and fewer cardiac complications. These observations may be explained by the cardioprotective properties of beta-blockers, which reduce myocardial oxygen demand and stabilize cardiac rhythm. Additionally, improved wound healing observed in the beta-blocker cohort may be related to reduced hypermetabolism and enhanced anabolic balance. Burn injuries are known to induce prolonged catabolism, and beta-adrenergic blockade may help counteract this response. Despite these promising findings, several limitations must be considered. The relatively small sample size increases the risk of type I statistical error. Furthermore, the observational design prevents definitive conclusions regarding causality. Nevertheless, the consistency of improved outcomes across multiple clinical parameters suggests that beta-blocker therapy may play a beneficial role in burn management. Burn injury triggers a sustained sympathetic response that significantly alters metabolic and cardiovascular physiology. Persistent catecholamine release contributes to increased energy expenditure, accelerated muscle protein breakdown, and heightened cardiac workload. Beta-adrenergic blockers have been proposed as a therapeutic strategy to counteract these responses. The present study evaluates the clinical impact of beta-blocker exposure in burn patients by comparing outcomes among individuals with prior beta-blocker therapy, those initiated on beta-blockers during hospitalization, and matched controls. Our findings suggest that patients with pre-injury beta-blocker therapy experienced fewer cardiovascular complications and improved wound healing outcomes compared with controls. These observations support the hypothesis that attenuation of hyperadrenergic stress may play an important role in improving recovery after burn injury. The assumption is that the beta-blockers exert their cardioprotective effect and attenuation of catabolic response by decreasing exaggerated sympathetic stimulation.^{7,8} This article should be judged in light of other published evidence of improved outcome with beta-blockers. Our aim is to demonstrate that a prospective, randomized study in burn patients using beta-blockers is logical and ethical. Use of a beta1-antagonist, such as metoprolol, may be a better choice, because these agents can be used in inhalation injury (10% of PMH BB patients had inhalation injury) with less fear of bronchospasm, and there may be an improved anabolic response by not inhibiting beta2-receptors, as already discussed.²⁰

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Conflict of interest: None Declared

Ethical approval: The study was approved by the institutional ethics committee.

CONCLUSION

Beta-blocker therapy appears to provide cardioprotective and metabolic benefits in burn patients, potentially improving survival and accelerating wound healing. Patients receiving beta-blockers prior to injury demonstrated reduced mortality and fewer cardiovascular complications.

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