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Comparative Evaluation of Cardioselective vs Non-Cardioselective Beta Blockers in Chronic Heart Failure: Impact on Functional Status, Cardiac Performance, and Safety Profile Over Six Months

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ABSTRACT

Background: Although beta-blockers have become essential components in the treatment of chronic heart failure based upon the established guidelines for the medical management of chronic heart failure, there are very few direct comparisons between the effectiveness of cardioselective and non-cardioselective beta-blockers to date.

Methods: The study comprised an evaluation of 140 patients diagnosed with congestive heart failure (NYHA Class II-III with LVEF <= 40%) over 6 months. Before the start of the trial, patients were grouped as either Category A (non cardioselective, including the majority of patients receiving carvedilol; 70 patients total) or Category B (Cardioselective [including bisoprolol, metoprolol succinate and nebivolol]; 70 patients total). Clinical, biochemical and echocardiographic parameters were evaluated on patients at baseline as well as at the end of the evaluation period (6 months post randomization).

Results: Improvement in functional recovery was seen amongst those in Category B relative to those in Category A, with a higher proportion of individuals from Category B improving to Class I and a lower proportion in Class III after 6 months. In addition, category B also had improved echocardiographic myocardial recovery and a decrease in the left atrial volume (p=0.042), pulmonary artery pressure (p= 0.017) and the level of B-type natriuretic peptide (p=0.021).

Conclusion: Cardio-selective beta-blockers enhance functional recovery, reverse ventricular remodeling, and promote clinical stability through lower hospitalizations; essentially, they have similar safety and tolerability to non-cardioselective medications.

Key-words: Congestive Heart Failure, Beta-blockers, Cardioselective beta-blockers, Left ventricular ejection fraction, Heart failure hospitalization

INTRODUCTION

The most commonly treated arrhythmia is Atrial fibrillation (AF), which is related to the rise of morbidity and mortality cases [1]. Estimation suggests that approximately 14 million people will be impacted by AF, which is as high as 25%, as observed in various studies [2]. Both diseases have common risk factors and other pathophysiological mechanisms, which include pulmonary hypertension, hypoxia, oxidative stress, and inflammation. Non-cardioselective BBs block the beta-1- and beta-2-adrenergic receptors, which results in a diversified impact of pharmacodynamics rather than cardioselective BBs. The most significant role in the prescribing dilemma among COPD patients is the

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effective bronchoconstriction due to the blockage of the eta-2-adrenergic receptor in the lungs. This impact is considered a problematic condition among individuals, along with other lung diseases. These cardioselective BBs are 20 times more effective and have high affinity for the beta-1-receptors compared with the beta-2-receptors and should be associated with a low risk of bronchoconstriction [3].

Both the absorption of cardioselective and non-cardioselective BBs occurs in the gastrointestinal tract, and high plasma concentration takes place within 1 to 3 hours. This results in reduced impact of the adrenaline and noradrenaline, lowers the heart rate, blood pressure and the contractile nature of the heart. This is metabolised in the liver through the cytochrome P450 system and is eliminated by excretion. The metabolic process and the elimination of BBs widely vary on the basis of the specific type of drug, which impacts the duration and the efficacy of the drug–drug interactions [4].

Also, the selective beta-blockers are related to the beta-1-blockers, which are associated with the survival advantage among COPD patients and chronic heart failure (HF) or myocardial infarction. However, there is no evidence for the BB cardioselectivity and prolonged outcome among AF and COPD patients [5]. Some studies have suggested that beta-blockers can be associated with a low rate of mortality from COPD exacerbations. It is clinically significant that β2-agonists are one of the first-line treatment options for COPD exacerbations [6].

The beta-blockers and β2-agonists show competitive binding with the β2-receptor; thus, the beta-blocker therapy may impede the bronchodilator response associated with the β2-agonist inhalers. A study showed that the non-selective beta-blocker reduces the bronchodilator response to the beta-agonist, while the selective beta-blockers do not. The β1 selectivity is the dose-dependent process, the impact of the cardio-selective beta-blockers on the airway at high doses. The reduction in the impact of the exercise is a significant cause of disability among COPD patients, and the exercise training has improved the symptoms and health-related quality of life [7]. This is a comparative study among the cardioselective and non-cardioselective beta-blockers in chronic heart failure, regarding the functional status and the cardiac efficacy, safety profile and the respiratory impacts over 6 months.

MATERIALS AND METHODS

Study Design- This study was a prospective, observational, parallel graduate cohort that evaluated and compared the long-term effects of cardio-selective beta-adrenergic receptor blockers versus non-cardioselective beta-adrenoceptor blockade in patients with chronic ventricular congestive heart failure. The primary purpose of this design was to study the ongoing transition of therapy in actual clinical practice; the functional status change during therapy, and the physiological change whilst on therapy, using a defined period of 6 months to monitor each of these transitions.

Study Setting and Temporal Horizon- The clinical trial was carried out as part of the Department of Cardiology at Santosh Medical College and Hospital's specialized tertiary care infrastructure and had a total study lifecycle of 18 months. To meet our objectives for completing the trial within this time frame, we divided the study's lifecycle into three functional phases: the enrollment phase where patients were systematically screened, informed consent obtained, baseline clinical evaluations completed and cohorts created; the active monitoring phase where enrolled patients received a standardised and uninterrupted 6-month period of therapeutic treatment with 5 clinical evaluations per participant; and the data analysis phase where database lock, statistical analysis, quality assurance audits, and clinical report generation for all participants occurred.

Sample Size Calculation and Statistical Powering- The sample size for the trial was determined before the trial occurred to help ensure that scientifically robust and statistically defensible conclusions would be obtained. The calculation of sample size was performed using power analysis software based on one of the primary efficacy endpoints, the absolute change in left ventricular ejection fraction from baseline to 6 months after initiation of therapy. Based on historical clinical trials, the researchers considered a clinically significant difference in ejection fraction between differing beta-blocker strategies (when comparing the two strategy groups) would be 3.5% with an SD of 7.0%. A two-tailed alpha standard of 0.05 and a target power of 80% were used to calculate the sample size to compare the two parallel, independent arms of this study; thus, a reasonable estimate of 63 patients per treatment arm

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was required. To compensate for a 10% dropout rate due to loss-to-follow-up, voluntary dropouts, or clinical mortality, an additional 140 patients would be recruited for a final analysis, 70 patients per cohort, to ensure the statistical power needed for the final analysis of the data.

Sampling Methodology- Patients were enrolled using consecutive sampling methods to enrol patients who presented as consecutive patients at outpatient cardiology clinics or were admitted as step-down patients in cardiac units. Each consecutive patient who met the diagnostic criteria for chronic heart failure was systematically assessed for inclusion/exclusion using pre-defined inclusion/exclusion criteria. This method reduced selection bias and provided an accurate cross-section of the real-world heart failure population treated at a tertiary care hospital.

Inclusion Criteria

- Clinically diagnosed CHF classified as NYHA Class II–III
- LVEF ≤ 40% as determined by 2D echocardiography
- On stable guideline-directed medical therapy for CHF for at least two weeks before enrolment
- Informed permission was provided, and participants were willing to comply with the
- protocols of the research as well as follow-up visits.

Exclusion Criteria

- Severe bradycardia (<50 bpm) or hypotension (systolic BP <90 mmHg)
- Combination use of cardio- and non-cardio-selective beta-blockers
- Pregnancy or lactation
- Hepatic dysfunction (ALT/AST >3× upper normal limit)

Procedure- Theoretically classified in Category A were individuals receiving a non-cardioselective beta-blocker that affects both the beta-1 and beta-2 receptor types of action. Carvedilol is the most commonly prescribed agent within this group, starting at a dose of 3.125 mg twice per day and titrated until reaching a maximum dose of 25-50 mg twice per day. Classical non-selective beta-blockers such as propranolol or atenolol were recorded in the study but were not commonly utilized as the primary treatment for left-sided heart failure.

Patients in Category B received cardioselective beta-blockers that were very selective for β1 receptors, such as bisoprolol, which was started at 1.25 mg daily and titrated to ten mg daily; metoprolol succinate (Extended-Release), which was started at 12.5–25 mg daily and titrated to 200 mg daily; and nebivolol, which was started at 1.25 mg daily and titrated to ten mg daily.

Outcome Assessment

Primary Endpoints- There were two main endpoints for the investigation, looking at efficacy. The efficacy-based functional shift compared the categorical change in the patient's NYHA functional class between baseline and the six-month follow-up and looked at how the treatment impacted clinical functioning, capacity, and symptom limitation. The second primary endpoint was echocardiographic myocardial recovery. This measure was assessed as an absolute quantitative change from baseline to the six-month assessment in Left Ventricular Ejection Fraction.

Secondary Endpoints- Secondary endpoints were those related to heart failure hospitalizations, such as unplanned admissions or emergency visits for IV diuresis, and therapy discontinuation / tapering due to intolerability. In addition, neurohormonal response was measured with serial testing of brain natriuretic peptide levels. In addition, long-term trends in resting heart rate and blood pressure were used to evaluate hemodynamic stability. Similarly, left atrial volume index and ratios of diastolic filling velocity were used to evaluate ventricular remodelling.

Statistical Analysis- All analyses used statistical software except for any two-tailed hypothesis testing at a level (p=0.05). Continuous variables were tested for normality using both visual and statistical tests, and were summarised by mean and standard deviation (SD) or median and inter-quartile range (IQR). Categorical variables are summarised as total number and proportion; group comparison utilises an independent samples t-test or Mann-Whitney U test. Pearson chi-square test or Fisher's exact test was used for categorical evaluation, and multivariable linear regression was conducted, adjusting for baseline covariates; the resulting odds ratios were calculated along with the upper and lower bounds (95% CI).

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RESULTS

Table 1 showed that the majority of patients were middle-aged to elderly, with the highest number of patients found in the 41-60 years old range (48.57% for Category A and 42.86% for Category B; p = 0.636). Both treatment groups showed male predominance, with 71.43% of patients in Category A being male and 74.29% in Category B (p = 0.697). During the six-month observation period, the Body Mass Index (BMI) of both groups of patients decreased slightly and gradually from baseline to the six-month assessment (from 26.11 to 25.88 in Category A, and from 26.45 to 25.66 in Category B). These are not statistically significant within Category A (p = 0.284) or Category B (p = 0.211), indicating that neither treatment with cardioselective beta-blockers nor non-cardioselective beta-blockers impacted the patient's body mass.

Table 1: Baseline Demographics and Longitudinal Body Mass Index (BMI) of the Study Cohort

Parameter /Cohort Group	Category A (n=70)	Category B (n=70)	Total (n=140)	p-value
Age Category (Years)				
* 18–40	10 (14.29%)	12 (17.14%)	22 (15.71%)	0.636
* 41–60	34 (48.57%)	30(42.86%)	64(45.71%)	
* 61–75	26 (37.14%)	28(40%)	54 (38.57%)	
Gender				
* Male	50 (71.43%)	52(74.29%)	102(72.86%)	0.697
* Female	20 (28.57%)	18(25.71%)	38 (27.14%)	
Body Mass Index (BMI) over Time (kg/m²)				
* Baseline BMI	26.11 ± 3.92	26.45 ± 4.05	-	-
* 1-Month BMI	25.97 ± 3.88	26.22 ± 4.01	-	-
* 3-Month BMI	25.91 ± 3.82	25.88 ± 3.95	-	-
* 6-Month BMI	25.88 ± 3.78	25.66 ± 3.91	-	-
* *p-value (Overall Longitudinal Trend)*	*0.284*	*0.211*	-	-

Table 2 showed the functional recovery of patients treated with Category B therapies, with 11.43% of patients reaching NYHA Class I by six months, as opposed to 34.29% of patients classified as Class III at enrolment and only 22.86% at the end of the six months, while Category A patients demonstrated no functional improvements (p = 0.002). The patients treated with cardio-selective beta-blockers showed a higher degree of improvement in Left Ventricular Ejection Fraction, with a mean improvement of 7.76% for patients in Category B, versus only 4.43% for patients in Category A (p = 0.037). These led to a clinical benefit for patients treated with cardio-selective beta-blockers. The incidence of patients requiring at least one unplanned hospital admission to treat worsening heart failure was nearly halved in patients treated with cardio-selective medications (12.86% versus 25.71% in patients receiving non-selective therapies; p = 0.043), demonstrating the efficacy of Category B therapies.

Table 2: Clinical, Hemodynamic, and Echocardiographic Outcomes Over Six Months

Parameter / Assessment Point	Category A (n=70)	Category B (n=70)	p-value
New York Heart Association (NYHA) Functional Class			
* Class I			
— Baseline	0 (0.00%)	0 (0%)	-
— 1 Month	0 (0.00%)	2 (2.86%)	0.15
— 3 Months	4 (5.71%)	6 (8.57%)	0.51

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— 6 Months	4 (5.71%)	8 (11.43%)	0.00**
* Class II			
— Baseline	42 (60.00%)	46 (65.71%)	0.46
— 1 Month	38 (54.29%)	44 (62.86%)	0.31
— 3 Months	36 (51.43%)	42 (60%)	0.28
— 6 Months	38 (54.29%)	46 (65.71%)	0.16
* Class III			
— Baseline	28 (40.00%)	24 (34.29%)	—
— 1 Month	32 (45.71%)	24 (34.29%)	0.149
— 3 Months	30 (42.86%)	20 (28.57%)	0.072
— 6 Months	28 (40.00%)	16 (22.86%)	0.00**
Left Ventricular Ejection Fraction (LVEF %)			
* Baseline LVEF	31.45 ± 5.62	31.21 ± 5.74	-
* 6-Month LVEF	35.88 ± 6.01	38.97 ± 5.69	-
* Mean Change ± SD	4.43 ± 2.78	7.76 ± 3.10	0.03**
Hemodynamic Profiles			
* Heart Rate (bpm)			
— Baseline	84.12 ± 8.67	85.23 ± 9.02	-
— 6 Months	76.04 ± 7.83	70.56 ± 6.72	-
— p-value (Within-Group Change)	*0.01***	*0.00***	-
* Systolic Blood Pressure (mmHg)			
— Baseline	116.54 ± 9.82	118.33 ± 10.14	-
— 6 Months	112.10 ± 10.37	111.68 ± 8.92	-
— p-value (Within-Group Change)	*0.07*	*0.04**	-
* Diastolic Blood Pressure (mmHg)			
— Baseline	76.32 ± 7.88	76.67 ± 8.11	-
— 6 Months	74.14 ± 7.21	72.84 ± 6.58	-
— p-value (Within-Group Change)	*0.08*	*0.03**	-
Heart Failure Hospital Admissions (6 Months)			
* ≥1 Admission	18 (25.71%)	9 (12.86%)	0.04**
* No Admission	52 (74.29%)	61 (87.14%)	-

Table 3 showed that both cardio-selective and non-cardio-selective beta blockers demonstrated similar safety and tolerability profiles. Cardio-selective beta blockade has higher bradycardia (14.29 vs 8.57%; p=0.28) and hypotensive (8.57 vs 5.71%; p=0.513). Contrastingly, non-cardio-selective agents had higher rates of fatigue (14.29% vs. 11.43%) and dizziness (14.29% vs. 11.43%) due to peripheral beta 2 blockade. Therefore, while there were only minor differences noted between the two classes of beta blockers in terms of side effects, clinical adherence did not suffer from these small differences, given the statistically equivalent and low overall rates of discontinuation between Category A (8.57%) and Category B (5.71%; p=0.47). This confirms that both beta-blocker treatment strategies are very well-tolerated among chronic heart failure patients. (Table 3).

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Table 3: Safety Profile, Adverse Drug Reactions, and Discontinuation Rates Over Six Months

Parameter / Safety Outcome	Category A (n=70)	Category B (n=70)	p-value
Adverse Drug Reactions			
* Bradycardia	6 (8.57%)	10 (14.29%)	0.28
* Hypotension	4 (5.71%)	6 (8.57%)	0.51
* Fatigue / Dizziness	10 (14.29%)	8 (11.43%)	0.61
Therapeutic Discontinuation			
* Discontinued Therapy	6 (8.57%)	4 (5.71%)	0.47
* Continued Therapy	64 (91.43%)	66 (94.29%)	-

Patients, who received a cardioselective beta-blocker had better cardiac remodelling and neurohormonal unloading than patients receiving non-cardioselective beta-blockers after 6 months of therapy. There was a reduction in myocardial wall stress in Group B than in Group A, with a highly significant reduction in NT-proBNP levels (p = 0.021 for Group B compared to p = 0.048 for Group A) in over 80% of both groups. Significant cardiac unloading for Group B was further corroborated by improvements in structural outcomes: Group B had a statistically significant decrease in Left Atrial Volume from 43.98 mL to 40.21 mL (p = 0.042), and a decrease in Pulmonary Artery Pressure from 35.10 mm Hg to 30.23 mm Hg (p = 0.017). Group A had a minimal (statistically insignificant) reduction in Left Atrial Volume (p = 0.098) and Pulmonary Artery Pressure (p = 0.072) (Table 4).

Table 4: Biochemical, Metabolic, and Echocardiographic Remodeling Markers Over Six Months

Parameter / Assessment Point	Category A	Category B	p-value
NT-proBNP Biomarker Profile			
* NT-proBNP Levels (pg/mL)			
— Baseline	2556.34 ± 740.23	2482.56 ± 792.11	-
— 6 Months	1867.45 ± 610.12	1611.78 ± 580.90	-
— p-value (Within-Group Change)	*0.048***	*0.021***	-
* NT-proBNP Availability	*(n=70)*	*(n=70)*	
— Tested (n, %)	58 (82.86%)	60 (85.71%)	-
— Not Tested (n, %)	12 (17.14%)	10 (14.29%)	-
Serum Electrolytes			
* Potassium (K^+, mmol/L)			
— Baseline	4.32 ± 0.46	4.30 ± 0.49	-
— 6 Months	4.24 ± 0.41	4.19 ± 0.43	-
— p-value (Within-Group Change)	*0.287*	*0.203*	-
Liver Function Tests (U/L)			
* Alanine Aminotransferase (ALT)			
— Baseline	31.43 ± 8.10	30.98 ± 7.74	-
— 6 Months	30.21 ± 7.98	29.34 ± 7.55	-
* Aspartate Aminotransferase (AST)			
— Baseline	32.55 ± 7.94	33.11 ± 8.10	-
— 6 Months	31.12 ± 8.23	30.88 ± 7.90	-
— p-value (Overall Longitudinal Trend)	*0.31*	*0.26*	-
Renal Function Profile			
* Creatinine (mg/dL)			
— Baseline	1.12 ± 0.28	1.15 ± 0.30	-

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— 6 Months	1.10 ± 0.26	1.08 ± 0.24	-
— *p-value (Within-Group Change)*	*0.47*	*0.39*	-
* Urea (mg/dL)			
— Baseline	35.14 ± 8.92	36.02 ± 9.01	-
— 6 Months	34.23 ± 8.76	33.10 ± 8.14	-
— *p-value (Within-Group Change)*	*0.53*	*0.12*	-
* eGFR (mL/min/1.73m²)			
— Baseline	62.45 ± 12.76	61.89 ± 11.98	-
— 6 Months	63.10 ± 11.45	64.32 ± 10.83	-
— *p-value (Within-Group Change)*	*0.60*	*0.28*	-
Structural Echocardiographic Remodeling			
* Left Atrial Volume (mL)			
— Baseline	44.67 ± 6.34	43.98 ± 5.72	-
— 6 Months	42.78 ± 5.93	40.21 ± 5.41	-
— *p-value (Within-Group Change)*	*0.09*	*0.04***	-
* Pulmonary Artery Pressure (mmHg)			
— Baseline	34.55 ± 5.91	35.10 ± 6.04	-
— 6 Months	32.61 ± 6.04	30.23 ± 5.88	-
— *p-value (Within-Group Change)*	*0.07*	*0.01***	-

Table 5 showed patient compliance was statistically equivalent between the two cohorts (Category B - 90.00% versus Category A - 85.71%, p = 0.627). The overall multiple regression analysis was highly significant (p < 0.001) and approximately 41.2% of the variance in Left Ventricular Ejection Fraction (LVEF) improvement over six months. A cardioselective agent was the strongest positive predictor of systolic improvement. Patients on cardioselective beta-blockers experienced an average additional increase of 2.874% in ejection fraction compared to patients not receiving cardioselective therapy. Treatment adherence was an independent contributor to positive systolic recovery (B = 1.216, p = 0.034). High baseline ejection fraction (B = -0.321, p < 0.001), greater severity of heart failure symptoms according to baseline NYHA Class III status (B = -1.456, p = 0.034), and increased myocardial wall stress were negative predictors of systolic recovery.

Table 5: Treatment Adherence and Multivariable Predictors of LVEF Improvement at Six Months

Cohort Group		**Good Adherence (≥85%)**	**Poor Adherence (<85%)**	**p-value**	
Category A (n=70)		60 (85.71%)	10 (14.29%)	0.627	
Category B (n=70)		63 (90.00%)	7 (10.00%)		
Predictor Variable	**Unstandardized Coefficient (B)**	**Standard Error (SE)**	**Standardized Coefficient (β)**	**t-value**	**p-value**
Age (years)	-0.04	0.03	-0.11	-1.54	0.12
Baseline LVEF (%)	-0.32	0.08	-0.31	-3.91	<0.001
NYHA Class (III vs II)	-1.45	0.67	-0.21	-2.14	0.03
Type of Beta-blocker (Cardioselective = 1)	2.87	0.89	0.32	3.21	0.00
Baseline NT-proBNP (pg/mL)	-0.00	0.00	-0.19	-2.15	0.03
Treatment Adherence (Good = 1)	1.21	0.56	0.19	2.14	0.03

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DISCUSSION

The study by Packer *et al.* is a randomized, double-blind trial, which demonstrated a significant improvement among heart failure patients. In comparison with placebo, carvedilol has reduced all-cause mortality by 35% and reduced the combined risk of death or hospitalization by 24% for a mean follow-up period of 10.4 months. Consistent benefits were noticed across all groups, including decompensation. The carvedilol was tolerated, with few treatment discontinuations due to negative impacts. These findings have extended the benefits of the beta-blockade from mild-to-moderate to more severe heart failure, which supported carvedilol as the most effective strategy to reduce the morbidity and mortality among advanced stages of disease [8]. Another large randomized controlled trial has shown that metoprolol CR/XL have improved the survival among patients with chronic heart failure. The mean follow-up period was one year, with metoprolol reducing the all-cause mortality by 34% rather than the placebo. The sudden cardiac death rate reduces, and the deaths occur due to heart failure. Metoprolol was well tolerated and effective, in addition to the standard therapy. The results established the cardioselective β1-blockade as an effective strategy in order to reduce mortality and showed better outcomes among chronic heart failure patients [9]. The review highlighted that both of the metoprolol and carvedilol have improved survival among the chronic heart failure. Some of the studies have suggested that carvedilol produces great improvement in the left ventricular ejection fraction for the blockage of the α1, along with other antioxidant impacts. There is no evidence that demonstrates the benefit of carvedilol over metoprolol in reducing mortality and improving the prognosis.

The difference in the activity of the β-adrenergic receptor impacts the tolerability, responsiveness and the capacity of the exercise. Both of the agents are effective, and substituted the metoprolol with carvedilol [10]. Another review paper emphasised that heart failure (HF) and chronic obstructive pulmonary disease coexist, sharing overlapping symptoms and pathophysiological mechanisms, which complicate the diagnosis and management. Accurate differentiation requires the use of echocardiography and pulmonary function tests, specifically among euvolemic patients.

The Natriuretic peptide levels help in diagnosis. COPD is detected as an independent predictor of high mortality and hospitalisation among HF patients. Both of the conditions worsen the prognosis, which highlights the need for cardiopulmonary management. Collaboration between cardiologists and pulmonologists is required for the optimization of the outcome and to reduce the morbidity and mortality [11]. The cardioselective beta-blockers showed no significant negative impacts on the respiratory function among patients with mild-to-moderate reactive airway disease. FEV_1 was noted for the single dose, which continued therapy, showed no change in the lung function, symptoms and use of inhaler. The beta-agonist responsiveness was restricted. Similar studies showed that patients with coexisting COPD. These supported the safe usage of the cardioselective beta-blockers among patients with respiratory disease, specifically showing the cardiovascular benefits for conditions like heart failure and arrhythmias [12].

CONCLUSIONS

The study concluded that the Cardioselective beta-blockers are more effective than non-cardioselective agents at treating congestive heart failure. Patients treated with cardioselective therapies experienced much greater clinical improvements than patients treated with non-cardioselective drugs. The physiological advantages achieved by patients with cardioselective agents resulted in a clinical advantage, nearly halving the number of unplanned hospitalizations for heart failure. Cardioselective and non-cardioselective agents showed similar rates of adverse events and treatment discontinuation. There was high degree of reverse cardiac remodelling and myocardial unloading associated with treatment using cardioselective beta-blockers; that is, patients treated with cardioselective agents will experience a statistically significant decrease in Left Atrial Volume and Pulmonary Artery The multivariable regression analysis showed that the use of cardioselective beta-blockers is a strong independent predictor of systolic recovery, demonstrating the validity of this class of medication as an effective treatment option for patients with chronic heart failure.

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