International Journal of Basic & Clinical Pharmacology
Nivasini NT et al. Int J Basic Clin Pharmacol. 2025 Sep;14(5):876-881
http://www.ijbcp.com
pISSN 2319-2003 | eISSN 2279-0780

DOI: https://dx.doi.org/10.18203/2319-2003.ijbcp20252591

Review Article

Landiolol in supraventricular tachycardia: an updated review of clinical applications

Natarajan Thangam Nivasini[1]*, P. V. Karthik[2], Arunkumar R.[1], Vikram Balaji[1], Kala P.[1], Jamuna Rani R.[1]

[1]Department of Pharmacology, SRM Medical College Hospital and Research Centre, Kanchipuram, Chennai, Tamil Nadu, India
[2]Parvathy Institute of Cardiac Sciences Parvathy Hospital, Chrompet, Chennai, Tamil Nadu, India

Received: 09 June 2025
Accepted: 07 July 2025

***Correspondence:**
Dr. Natarajan Thangam Nivasini,
Email: nivasini.natarajan@gmail.com

ABSTRACT

Supraventricular tachycardia (SVT) is a prevalent cardiac arrhythmia requiring rapid and effective intervention. Landiolol, a highly selective, ultra-short acting, beta-1 adrenergic receptor blocker, has recently received FDA approval for short-term ventricular rate control in adults with SVT, including atrial fibrillation and atrial flutter. Its rapid onset and hemodynamic stability make it a valuable addition to acute cardiac care. Data from clinical trials, systematic reviews, and real-world studies were analyzed to evaluate landiolol's role in SVT management. It effectively controls the ventricular rate in SVT. The drug exhibited a favourable safety profile and is better suited for rate control rather than arrhythmia termination when compared to adenosine. Its utility in managing perioperative atrial fibrillation, critically ill patients, and those with respiratory conditions makes it a valuable therapeutic option. Future research should explore its role in Indian demographics to optimize its clinical use.

Keywords: Landiolol, Supraventricular tachycardia, Beta-blockers, Atrial fibrillation, Cardiac arrhythmia, Ultra-short-acting beta-blocker

INTRODUCTION

Supraventricular tachycardia (SVT) comprises a spectrum of arrhythmias originating above the ventricles, including atrioventricular nodal re-entrant tachycardia (AVNRT), atrioventricular re-entrant tachycardia (AVRT), atrial tachycardia, and atrial fibrillation (AF)/flutter with rapid ventricular response.

Beta-blockers are commonly employed in SVT management, with landiolol emerging as a preferred agent due to its high cardioselectivity and ultra-short duration of action. Its rapid onset and precise titration are particularly beneficial in critical care settings.[1]

LANDIOLOL

Description

Landiolol is [(4S)-2,2-dimethyl-1,3-dioxolan-4-yl] methyl 3-[4-[(2S)-2-hydroxy-3- [2-morpholine-4-carbonylamino) ethylamino] propoxy] phenyl] propionate with the empirical formula C25H39N3O8. The structure of landiolol is shown in Figure 1.

HISTORY OF LANDIOLOL

Landiolol was first developed in Japan in the early 2000s by Ono Pharmaceutical Co. Ltd. It was designed as an ultra-short-acting beta-1 adrenergic receptor blocker with

superior hemodynamic stability compared to existing beta-blockers like esmolol. The drug was initially approved in Japan for tachyarrhythmia management in perioperative and critical care settings. Over the years, clinical trials have demonstrated its effectiveness in reducing heart rate with minimal impact on blood pressure and cardiac output, leading to its approval in European and American markets. The FDA approval in 2024 for use in SVT further solidifies its role in acute cardiac care worldwide.[2]

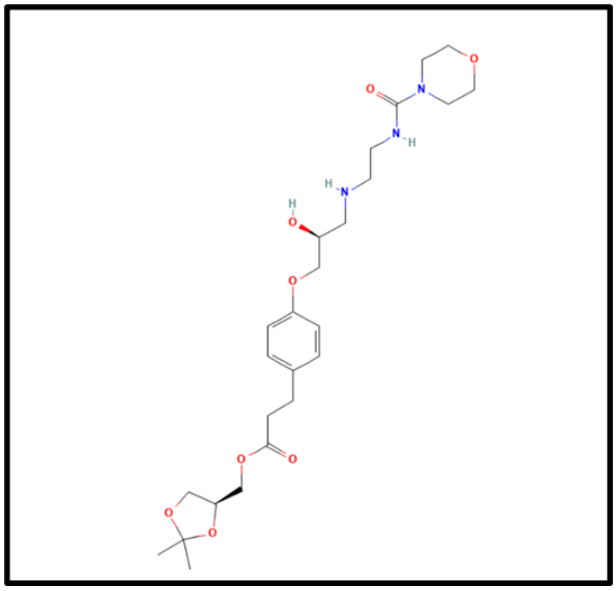

Figure 1: Structure of landiolol.

PHARMACOKINETICS AND PHARMACODYNAMICS

Landiolol selectively inhibits beta-1 adrenergic receptors, predominantly found in the heart, thereby reducing heart rate and myocardial oxygen demand. It has no intrinsic sympathomimetic activity or membrane-stabilizing effects. This specificity minimizes the risk of beta-2 receptor-mediated bronchoconstriction, a significant advantage in patients with reactive airway diseases. Landiolol's mechanism of action is illustrated in Figure 2.

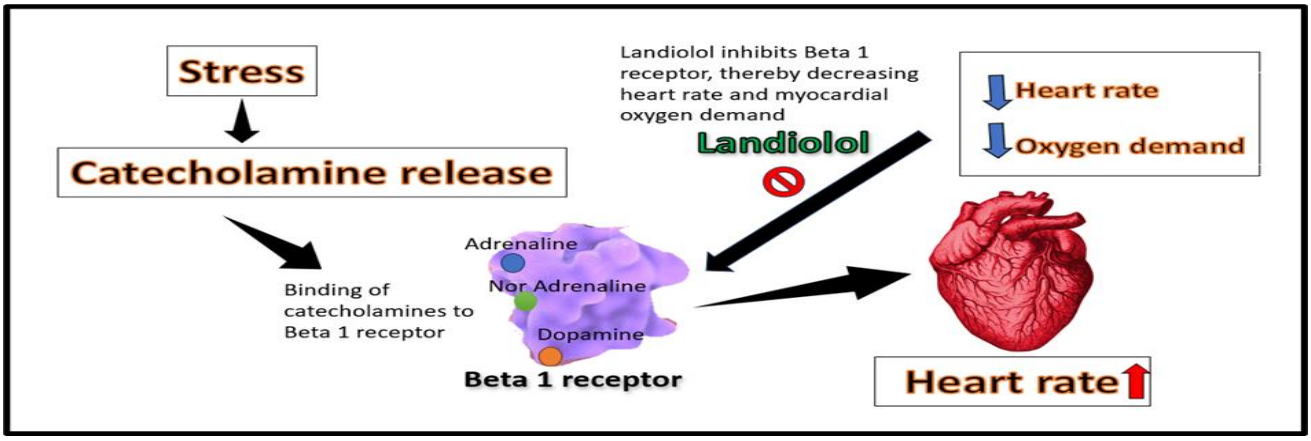

Figure 2: Mechanism of action of landiolol.

Pharmacokinetically, landiolol exhibits a rapid onset and ultra-short elimination half-life of approximately four minutes. This allows for quick titration and cessation of its effects, making it highly controllable in emergencies. The drug is metabolized in the plasma by pseudo-cholinesterase and carboxylesterases, resulting in an active metabolite, M1, which is significantly less potent than the parent compound. Its clearance is primarily renal, with minimal protein binding (<10%) and a steady-state volume of distribution of 0.4 l/kg.[3,4]

CLINICAL APPLICATIONS IN SVT

Landiolol is indicated for short-term ventricular rate control in SVT and has demonstrated efficacy in randomized controlled trials across various clinical settings. It is particularly effective in emergency and perioperative care, where it helps manage acute SVT episodes and perioperative AF or flutter, especially following cardiac surgery. In critical care settings, landiolol is preferred for hemodynamically unstable patients, including those with heart failure, sepsis, or those requiring mechanical ventilation, due to its rapid onset and precise titration. Additionally, it has proven beneficial in AF with rapid ventricular response (AF-RVR), effectively lowering ventricular rate while exerting minimal impact on blood pressure and cardiac output. Emerging evidence also supports its potential role in paediatric SVT, particularly in cases associated with congenital heart disease, highlighting it expanding the clinical applications.[5-7]

CLINICAL TRIALS

The clinical trials comparing the efficacy and safety of landiolol are illustrated in Table 1.

ADENOSINE VS LANDIOLOL

The comparison of adenosine and landiolol in the management of SVT and atrial arrhythmias is depicted in Table 2.[1,14]

Table 1: Summary of clinical trials comparing efficacy and safety of landiolol.[1,2,5,8-13]

Study/ comparison	Patient population/ condition	Findings	Efficacy outcome	Safety outcome
Landiolol vs. placebo	Postoperative or intraoperative SVT	Significant heart rate (HR) reduction	Superior to placebo	Well tolerated; low incidence of hypotension and bradycardia
Landiolol vs. digoxin	AF /flutter with left ventricular dysfunction	Greater HR reduction compared to digoxin	More effective rate control	Comparable safety profile
Landiolol vs. diltiazem	Postoperative AF (POAF)	More effective conversion to normal sinus rhythm (NSR)	Superior rhythm control	Fewer hemodynamic adverse effects
Perioperative landiolol vs. diltiazem/ placebo/no treatment	Patients undergoing cardiac and non-cardiac surgery	Reduced incidence of POAF within first postoperative week	Effective as prophylaxis	Well tolerated
Systematic review (15 studies)	SVT with left ventricular dysfunction	Mean HR reduction of 42 bpm; higher odds of achieving target HR (OR 5.37)	Superior rate control compared to other antiarrhythmics	Adverse events in 14.7% of patients; comparable to others
Landiolol vs. other therapies	SVT patients	No significant difference in sinus rhythm restoration	Equivalent rhythm control	Favorable safety profile
Meta-analysis: Esmolol vs. Landiolol	Sepsis with persistent tachycardia	No significant mortality reduction; results varied across studies	Inconclusive	Mixed outcomes; further studies needed
Pooled analysis of 7 RCTS (n=613)	Sepsis and septic shock	Potential short-term mortality benefit in persistent tachycardia	Promising, but lacks confirmation	Requires larger multicenter trials

Table 2: Comparative overview of adenosine and landiolol in the management of cardiac arrhythmias.

Parameters	Adenosine	Landiolol
Mechanism of action	Acts on A1 adenosine receptors to transiently block atrioventricular (AV) nodal conduction, interrupting re-entrant circuits.	Selective β_1-adrenergic receptor blocker; reduces heart rate by attenuating catecholaminergic stimulation.
Primary action	Terminates SVT by restoring sinus rhythm.	Controls ventricular rate in AF and atrial flutter
Indications	First-line agent for paroxysmal SVT due to AV nodal re-entry or accessory pathways (AVNRT/AVRT). Not effective in AF/flutter	Indicated for rate control in AF, atrial flutter, and postoperative arrhythmias.
Pharmacokinetics	Ultra-short half-life (<10 seconds) with rapid onset and offset of action.	Short half-life (~4 minutes); allows for rapid titration and sustained control during infusion
Efficacy	Highly effective (90–95%) for terminating PSVT; ineffective for AF or flutter.	Effective for ventricular rate control; does not restore sinus rhythm.
Safety profile	Common adverse effects: flushing, chest discomfort, dyspnea, transient bradycardia; contraindicated in severe asthma.	Adverse effects include hypotension and bradycardia; β_1-selectivity confers better safety in asthma/COPD.
Administration	Administered as a rapid intravenous bolus for acute arrhythmia termination.	Continuous intravenous infusion for rate control, typically in monitored settings.
Duration of action	Immediate onset with very brief duration (seconds).	Sustained effect during infusion with rapid offset upon discontinuation.

Continued.

Parameters	Adenosine	Landiolol
Clinical use cases	Acute termination of PSVT in hemodynamically stable patients.	Rate control in AF/flutter, particularly in patients with left ventricular dysfunction or instability.
Contraindications	Contraindicated in severe asthma, high-grade AV block without pacing, and sick sinus syndrome without a pacemaker.	Contraindicated in severe bradycardia, high-grade AV block, cardiogenic shock, and decompensated heart failure.

DOSAGE AND ADMINISTRATION

Landiolol's dosing regimen varies based on cardiac function, with specific recommendations by the FDA. For patients with normal cardiac function, the initial infusion is 9 mcg/kg/min, with titration at 10-minute intervals up to a maximum of 36 mcg/kg/min. In cases of impaired cardiac function, a more cautious approach is advised, starting with an initial dose of 1 mcg/kg/min, with titration intervals extended to 15 minutes to ensure patient safety. The reconstituted solution should be used promptly, following the specified stability guidelines to maintain its efficacy and prevent potential degradation.[3,15]

EFFICACY AND SAFETY

Clinical trials have demonstrated that landiolol effectively reduces heart rate in patients with SVT and atrial fibrillation with rapid ventricular response (AF-RVR), offering a favourable safety profile compared to esmolol or propranolol. Systematic reviews highlight a mean heart rate reduction of 42 beats per minute, with a significantly higher likelihood of achieving the target heart rate than alternative antiarrhythmic agents (odds ratio: 5.37). Adverse events were reported in 14.7% of landiolol-treated patients, a rate comparable to other beta-blockers, indicating a well-tolerated safety profile. Additionally, while landiolol was effective in heart rate control, it did not show a significant advantage in restoring sinus rhythm compared to other therapies.[5,16-18]

CONTRAINDICATIONS, WARNINGS, AND PRECAUTIONS

Although landiolol has a well-established safety profile, appropriate patient selection and monitoring are essential for prescribing landiolol. It is contraindicated in severe bradycardia (<50 bpm), second or third-degree atrioventricular block without a pacemaker, cardiogenic shock, severe hypotension, decompensated heart failure, and in patients with hypersensitivity to landiolol or other beta-blockers.

Caution should be exercised in patients at risk of hypotension, as landiolol can cause a significant reduction in blood pressure, necessitating close hemodynamic monitoring. Symptomatic bradycardia may require dose adjustments or discontinuation. In patients with heart failure, particularly those with reduced ejection fraction, careful dosing is required to avoid exacerbation of cardiac dysfunction. While landiolol is highly selective for beta-1 receptors, patients with severe asthma or chronic obstructive pulmonary disease (COPD) should be monitored for potential respiratory effects.

Hepatic and renal impairment may necessitate dose modifications, as the drug is metabolized by plasma enzymes but cleared through urine. Drug interactions should also be considered, especially with other negative chronotropic agents, as excessive suppression of heart rate can occur. Concomitant use with calcium channel blockers, digoxin, or antiarrhythmic agents should be carefully managed.[3]

CLINICAL TRIALS ON THE CAUCASIAN POPULATION:

Clinical trials, including studies conducted on Caucasian populations, have demonstrated that landiolol effectively reduces heart rate in patients with SVT and atrial fibrillation with rapid ventricular response (AF-RVR), offering a favourable safety profile compared to esmolol or propranolol. Systematic reviews highlight a mean heart rate reduction of 42 beats per minute, with a significantly higher likelihood of achieving the target heart rate than alternative antiarrhythmic agents (odds ratio: 5.37).

Studies on Caucasian patients have confirmed landiolol's efficacy in this population, showing consistent results in heart rate control with minimal hemodynamic compromise. Adverse events were reported in 14.7% of landiolol-treated patients, a rate comparable to other beta-blockers, indicating a well-tolerated safety profile. Additionally, while landiolol was effective in heart rate control, it did not show a significant advantage in restoring sinus rhythm when compared to other therapies.[19,20]

FUTURE PERSPECTIVES AND IMPLICATIONS FOR THE INDIAN POPULATION

Despite global recognition, dedicated trials assessing landiolol's effects in Indian patients are necessary. Future research should focus on: Pharmacokinetic and pharmacodynamic variations in Indian demographics, role in perioperative atrial fibrillation management, use in critically ill Indian patients with heart failure and sepsis and comparisons with commonly used beta-blockers in India, such as metoprolol and propranolol.

CONCLUSION

Landiolol's approval for SVT marks a significant advancement in acute cardiac care. Its rapid onset, ultra-short duration, and high beta-1 selectivity allow precise titration and quick cessation, making it ideal for managing acute arrhythmias, including in patients with airway diseases. Clinical trials confirm its efficacy in reducing heart rate with minimal hemodynamic impact, positioning it as a safer alternative to conventional beta-blockers. Ongoing research will further refine its role, particularly in diverse patient populations and complex cardiac scenarios.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: Not required

REFERENCES

1. Nasoufidou A, Papazoglou AS, Stachteas P, Karagiannidis E, Samaras A, Alexiou S, et al. Intravenous Landiolol for Rate Control in Supraventricular Tachyarrhythmias in Patients with Left Ventricular Dysfunction: A Systematic Review and Meta-Analysis. J Clin Med. 2024;13(6):1683.
2. Syed YY. Landiolol: A Review in Tachyarrhythmias. Drugs. 2018;78(3):377-88.
3. Research C for DE and Novel Drug Approvals for 2024. FDA. 2024. Available at: https://www.fda.gov/drugs/novel-drug-approvals-fda/novel-drug-approvals-2024. Accessed on 6 January 2025.
4. Floria M, Oancea AF, Morariu PC, Burlacu A, Iov DE, Chiriac CP, et al. An Overview of the Pharmacokinetics and Pharmacodynamics of Landiolol (an Ultra-Short Acting β1 Selective Antagonist) in Atrial Fibrillation. Pharmaceutics. 2024;16(4):517.
5. Si X, Yuan H, Shi R, Song W, Guo J, Jiang J, et al. Comparison of the efficacy and safety of Landiolol and Esmolol in critically ill patients: a propensity score-matched study. Ann Intensive Care. 2025;15(1):5.
6. Yoneyama F, Tokunaga C, Kato H, Nakajima T, Mathis BJ, Sakamoto H, et al. Landiolol Hydrochloride Rapidly Controls Junctional Ectopic Tachycardia After Pediatric Heart Surgery. Pediatr Crit Care Med. 2018;19(8):713.
7. Alexandru MG, Niewald P, Krüger S, Borgstedt R, Whitehouse T, Singer M, et al. Mortality in septic patients treated with short-acting betablockers: a comprehensive meta-analysis of randomized controlled trials. Crit Care. 2024;28:392.
8. Aoyama H, Otsuka Y, Aoyama Y. Landiolol infusion during general anesthesia does not prevent postoperative atrial fibrillation in patients undergoing lung resection. Gen Thorac Cardiovasc Surg. 2016;64(12):735-41.
9. Ferraris A, Jacquet-Lagrèze M, Cazenave L, Fornier W, Jalalzai W, Rousseau-Saine N, et al. Microcirculatory effects of landiolol: a double-blind, randomised, controlled study after cardiac surgery. Br J Anaesth. 2021;126(6):e212-4.
10. Levy B, Slama M, Lakbar I, Maizel J, Kato H, Leone M, et al. Landiolol for Treatment of New-Onset Atrial Fibrillation in Critical Care: A Systematic Review. J Clin Med. 2024;13(10):2951.
11. Kowalik K, Silverman M, Oraii A, Conen D, Belley-Côté EP, Healey JS, et al. Landiolol for perioperative atrial tachyarrhythmias in cardiac and thoracic surgery patients: a systematic review and meta-analysis. Br J Anaesth. 2024;133(1):222-5.
12. Sato R, Messina S, Hasegawa D, Santonocito C, Scimonello G, Sanfilippo G, et al. Mortality in Patients with Sepsis Treated with Esmolol or Landiolol: A Systematic Review and Meta-Analysis of Randomized Controlled Trials with Trial Sequential Analysis. Chest. 2025;167(1):121-38.
13. Hasegawa D, Sato R, Prasitlumkum N, Nishida K, Takahashi K, Yatabe T, et al. Effect of Ultrashort-Acting β-Blockers on Mortality in Patients with Sepsis with Persistent Tachycardia Despite Initial Resuscitation: A Systematic Review and Meta-analysis of Randomized Controlled Trials. Chest. 2021;159(6):2289-300.
14. Miyawaki IA, Gomes C, Caporal S, Moreira V, Marques RI, de Souza IAF, et al. The Single-Syringe Versus the Double-Syringe Techniques of Adenosine Administration for Supraventricular Tachycardia: A Systematic Review and Meta-Analysis. Am J Cardiovasc Drugs Drugs Devices Interv. 2023;23(4):341-53.
15. Krumpl G, Ulč I, Trebs M, Kadlecová P, Hodisch J, Maurer G, et al. Pharmacokinetics and Pharmacodynamics of Low-, Intermediate-, and High-Dose Landiolol and Esmolol During Long-Term Infusion in Healthy Whites. J Cardiovasc Pharmacol. 2018;71(3):137-46.
16. Kakihana Y, Nishida O, Taniguchi T, Okajima M, Morimatsu H, Ogura H, et al. Efficacy and safety of landiolol, an ultra-short-acting β1-selective antagonist, for treatment of sepsis-related tachyarrhythmia (J-Land 3S): a multicentre, open-label, randomised controlled trial. Lancet Respir Med. 2020;8(9):863-72.
17. Sezai A, Osaka S, Yaoita H, Ishii Y, Arimoto M, Hata H, et al. Safety and efficacy of landiolol hydrochloride for prevention of atrial fibrillation after cardiac surgery in patients with left ventricular dysfunction: Prevention of Atrial Fibrillation After Cardiac Surgery with Landiolol Hydrochloride for Left Ventricular Dysfunction (PLATON) trial. J Thorac Cardiovasc Surg. 2015;150(4):957-64.
18. Miyamoto M, Osawa K, Miyoshi T, Mori A, Yoshikawa M, Oka T, et al. Efficacy and Safety of Early Intravenous Landiolol on Myocardial Salvage in Patients with ST-segment Elevation Myocardial Infarction before Primary Percutaneous Coronary Intervention: A Randomized Study. Acta Med Okayama. 2021;75(3):289-97.

19. Krumpl G, Ulc I, Trebs M, Kadlecová P, Hodisch J. Bolus application of landiolol and esmolol: comparison of the pharmacokinetic and pharmacodynamic profiles in a healthy Caucasian group. Eur J Clin Pharmacol. 2017;73(4):417-28.
20. Krumpl G, Ulc I, Trebs M, Kadlecová P, Hodisch J. Pharmacokinetics and pharmacodynamics of two different landiolol formulations in a healthy Caucasian group. Eur J Pharm Sci Off J Eur Fed Pharm Sci. 2016;92:64-73.

Cite this article as: Nivasini NT, Karthik PV, Arunkumar R, Balaji V, Kala P, Rani JR. Landiolol in supraventricular tachycardia: an updated review of clinical applications. Int J Basic Clin Pharmacol 2025;14:876-81.