

Injectable In Situ Thermoreversible Gel Depot System of Lidocaine Nanoemulsion for Prolonged Anesthetic Activity in Dental and Operative Procedures

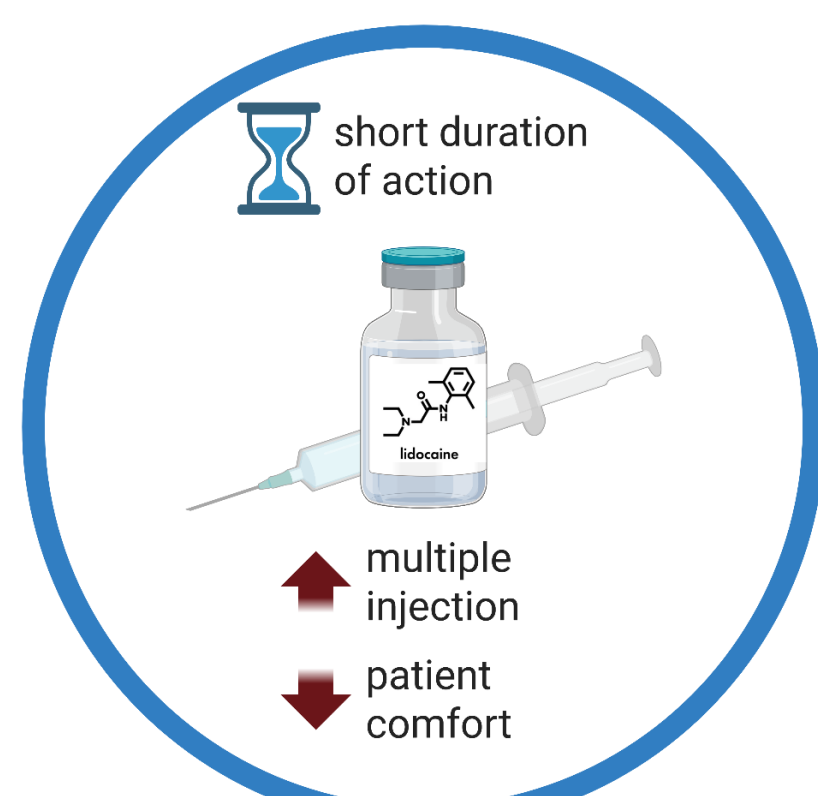
Shery Jacob^{1*}, Fathima Sheik Kather¹, Shakta Mani Satyam², Sai H. S. Boddu^{3,4}, Firas Assaf², Tasnem H. Abdelfattah Allam^{3,4}, and Anroop B. Nair⁵1. Department of Pharmaceutical Sciences, College of Pharmacy, Gulf Medical University, Ajman 4184, United Arab Emirates; fathima.sheik@gmu.ac.ae (F.S.K)2. Department of Pharmaceutics; RAK College of Pharmacy, RAK Medical and Health Sciences University, Ras Al Khaimah, UAE. satyam@rakmhsu.ac.ae (S.M.S); firas.22901067@rakmhsu.ac.ae (F.A)3. Department of Pharmaceutical Sciences, College of Pharmacy and Health Sciences, Ajman University, Ajman P.O. Box 346, United Arab Emirates; s.boddu@ajman.ac.ae (S.H.S.B.); 202110187@ajmanuni.ac.ae (T.A.A)

4. Center of Medical and Bio-Allied Health Sciences Research, Ajman University, Ajman, P.O. Box 346, United Arab Emirates

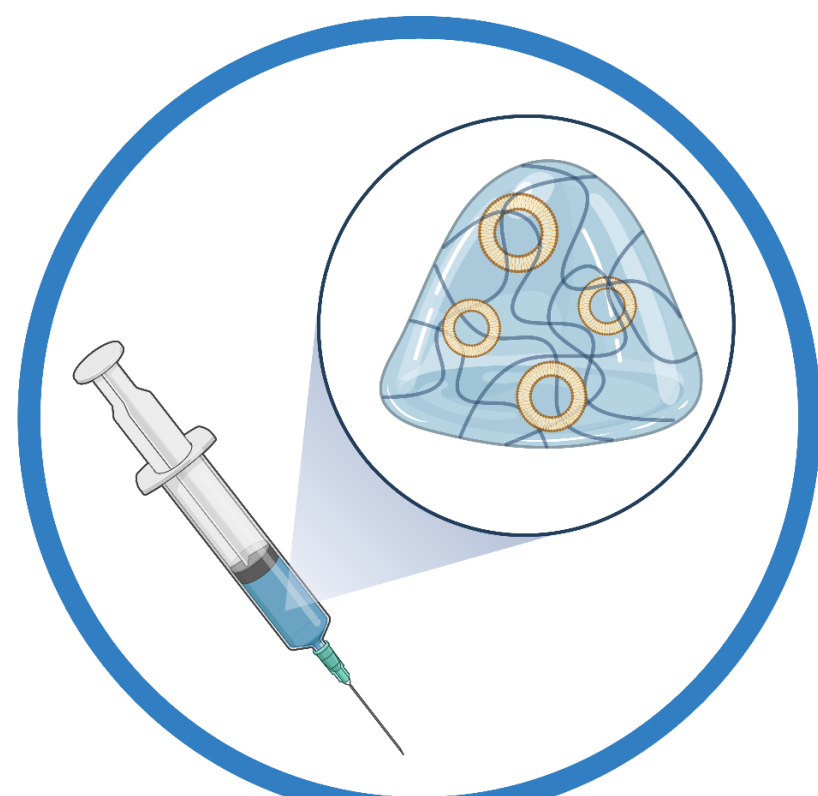
5. Department of Pharmaceutical Sciences, College of Clinical Pharmacy, King Faisal University, Al-Ahsa 31982, Saudi Arabia; anair@kfu.edu.sa (A.B.N.)*Correspondence: dr.sheryjacob@gmu.ac.ae; Tel.: +971-556221986

INTRODUCTION & AIM

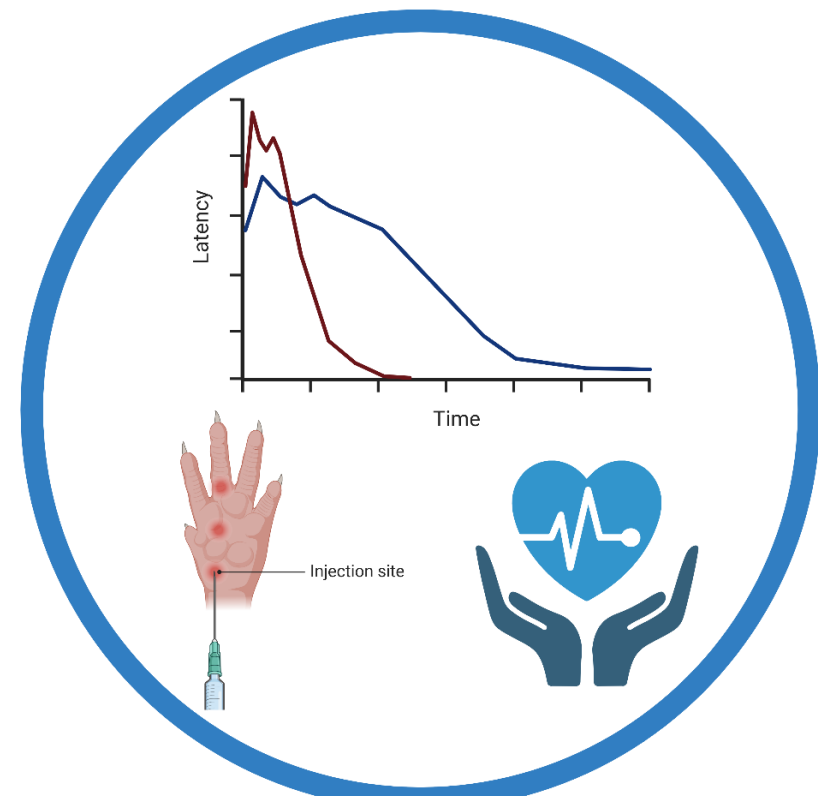
- Lidocaine hydrochloride (LD-HCl) is the most commonly used local anesthetic in dentistry, often administered with epinephrine to extend its duration and reduce systemic absorption.
- However, its relatively short duration of action, the need for repeated injections, and the unpleasant taste may limit patient compliance and procedural efficiency.
- This study aimed to develop and evaluate a novel injectable nanoemulsion-based in situ gel depot system of LD to provide prolonged anesthetic activity.



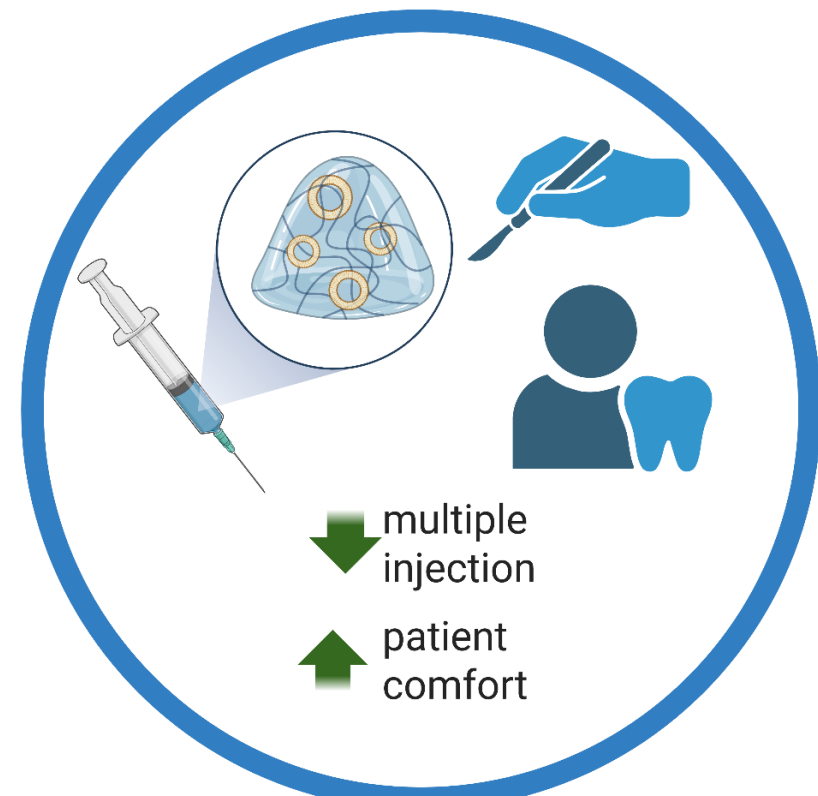
Problems with conventional Lidocaine HCl injectables



Lidocaine nanoemulsion incorporated in a thermosensitive hydrogel



Prolonged anesthetic activity with no cardiovascular adverse effects



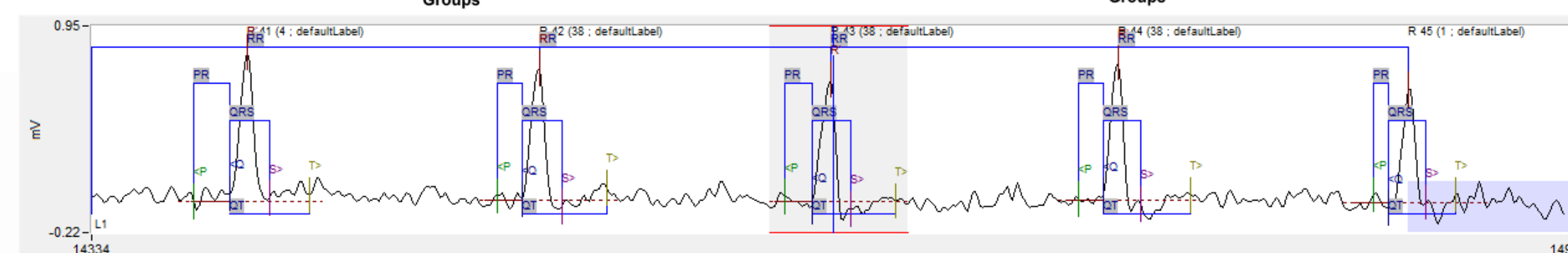
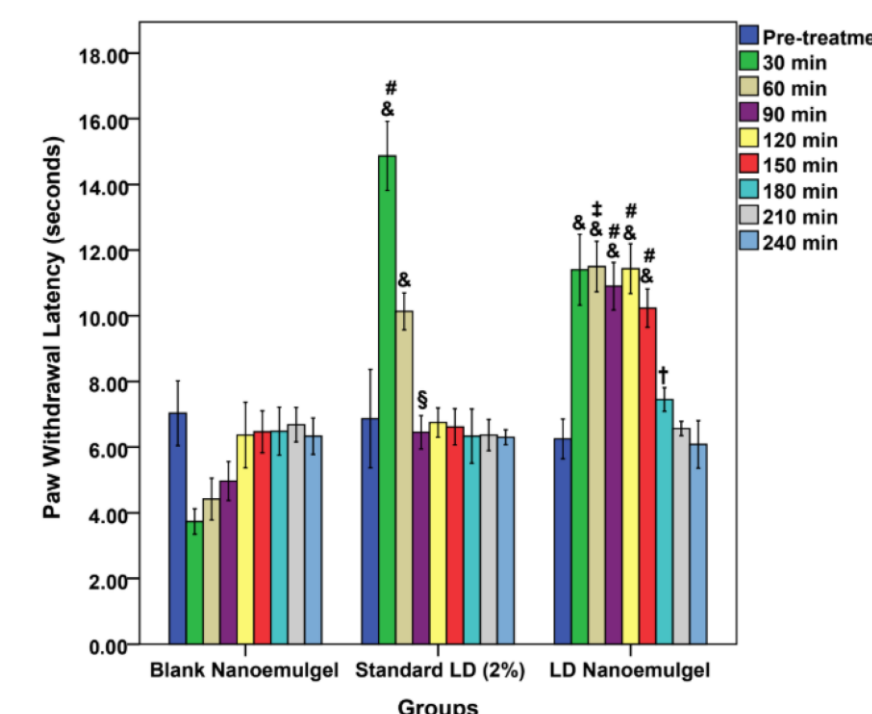
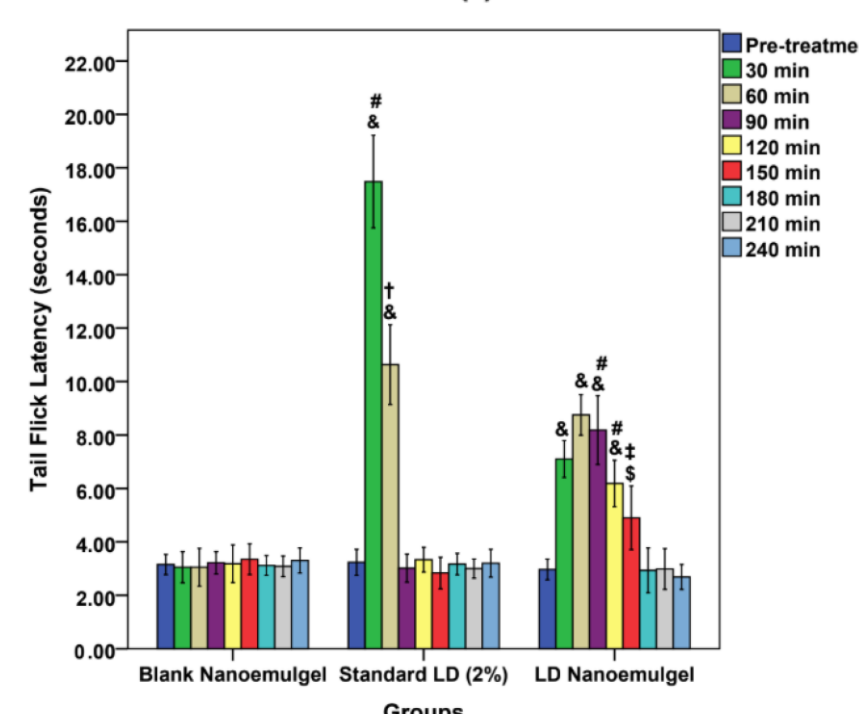
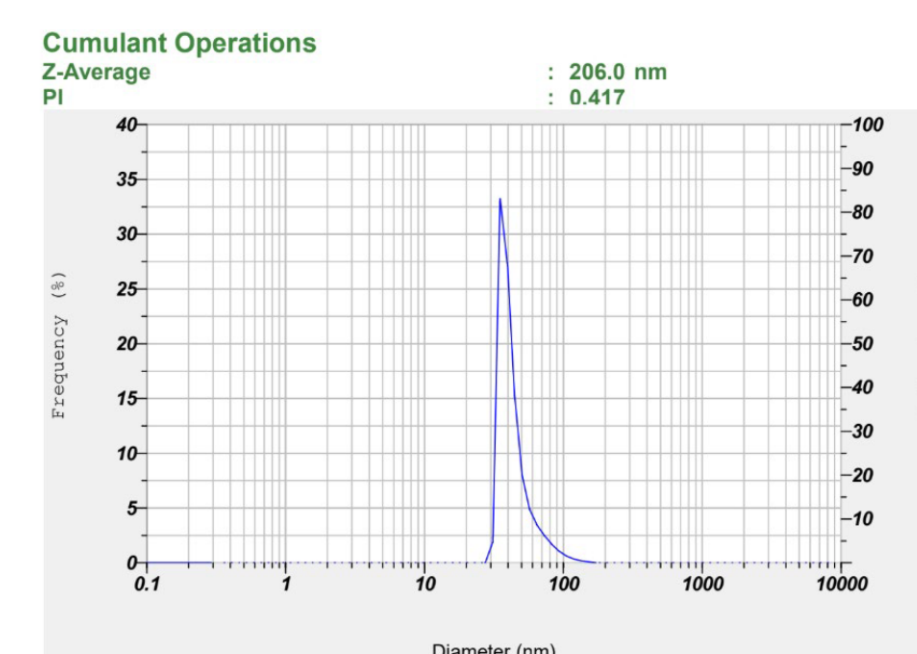
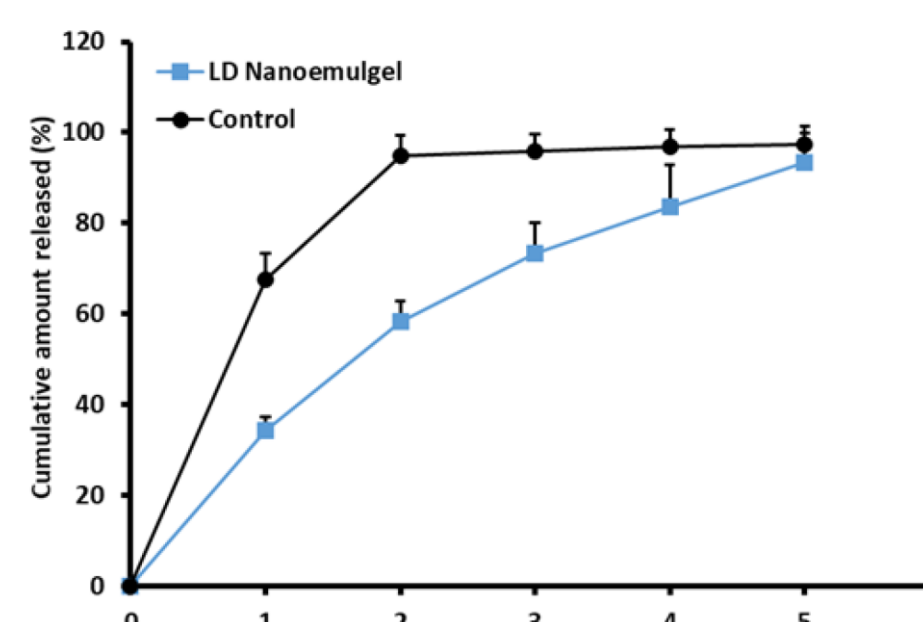
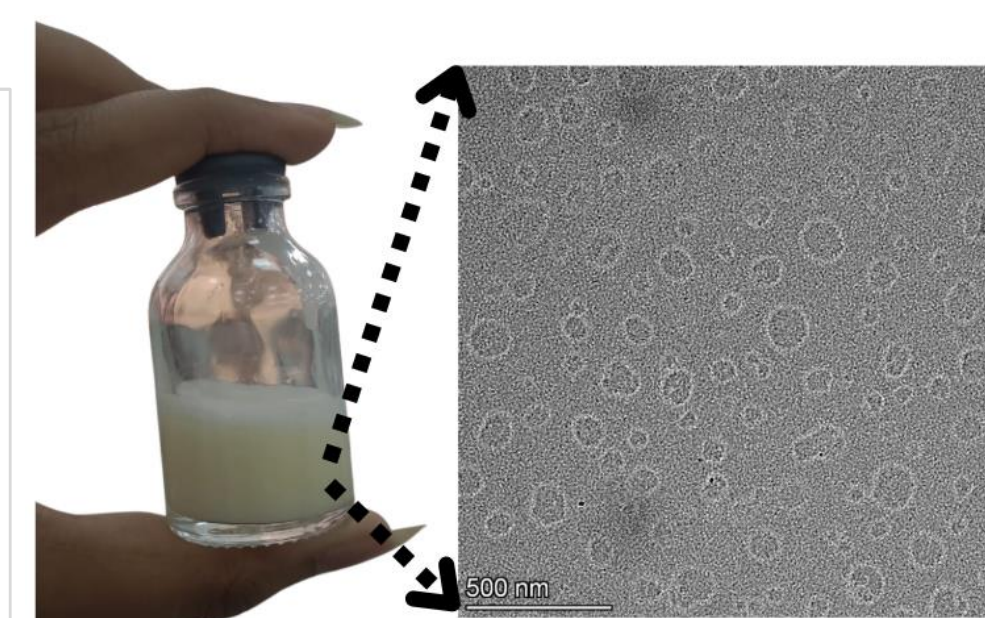
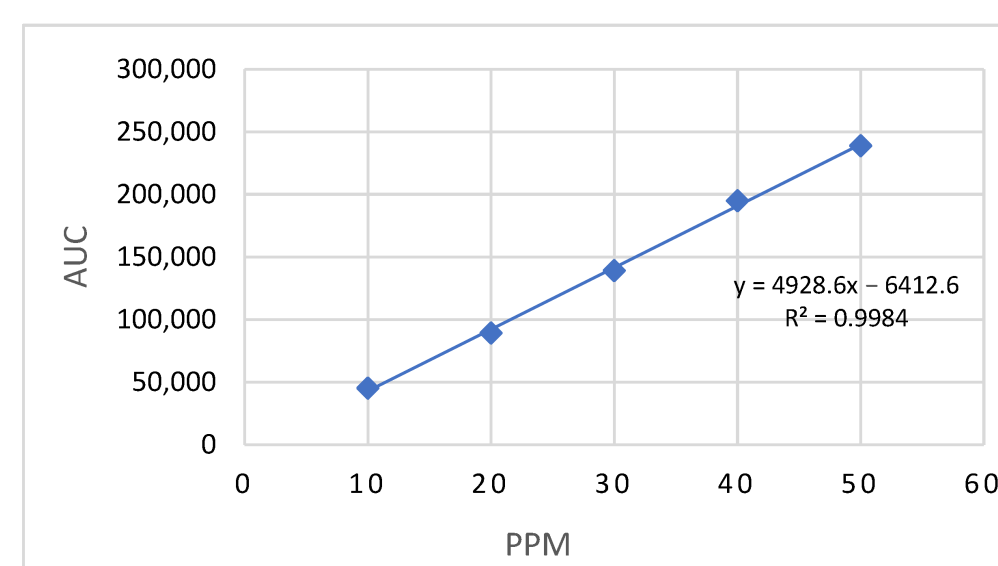
Better anesthetic outcomes for dental and surgical patients

METHOD

- LD-loaded nanoemulsions were formulated by high-shear homogenization followed by probe sonication, employing Miglyol 812 N (oil phase), a combination of Tween 80 and soy lecithin (surfactant-co-surfactant), glycerin (stabilizer), and deionized water (aqueous phase). The selected nanoemulsion was dispersed in a thermoreversible poloxamer solution to form a nanoemulgel.
- The preparation was evaluated for globule diameter and uniformity, zeta potential, surface morphology, pH, drug content, stability, rheological behavior, injectability, and in vitro drug release.
- Analgesic efficacy was assessed via tail-flick and thermal paw withdrawal latency tests in Wistar rats.
- Cardiovascular safety was monitored using non-invasive electrocardiography and blood pressure measurements.

RESULTS & DISCUSSION

- The developed nanoemulsions demonstrated a spherical shape, nanometer size (206 nm), high zeta-potential (−66.67 mV) and uniform size distribution, with a polydispersity index of approximately 0.40, while the nanoemulgel demonstrated appropriate thixotropic properties for parenteral administration.
- In vitro release profiles showed steady LD release (5 h), following the Higuchi model.



- In vivo studies showed significantly prolonged analgesic effects lasting up to 150 min (2.5 h) compared to standard LD-HCl injection (p < 0.001), with no adverse cardiovascular effects observed.

CONCLUSION

The developed injectable LD in situ nanoemulgel offers a promising, patient-friendly alternative for prolonged anesthetic delivery in dental and operative procedures, potentially reducing the need for repeated injections and enhancing procedural comfort.

REFERENCES

Link to Publication and references:

Jacob, S.; Kather, F. S.; Satyam, S. M.; Boddu, S. H. S.; Assaf, F.; Allam, T. H. A.; & Nair, A. B. (2025). Injectable In Situ Thermoreversible Gel Depot System of Lidocaine Nanoemulsion for Prolonged Anesthetic Activity in Dental and Operative Procedures. *Pharmaceutics*, 17(10), 1355. <https://doi.org/10.3390/pharmaceutics17101355>