RESEARCH PAPER

Effectiveness of Lignocaine as a Therapeutic Agent in Reducing Spasticity: A Prospective Observational Study of Multiple Intramuscular Injections

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ABSTRACT

Background: Spasticity resulting from upper motor neuron (UMN) lesions constitutes a major cause of functional disability and rehabilitation burden worldwide. Lignocaine (lidocaine), a widely available sodium channel blocker, has been proposed as an accessible alternative to botulinum toxin for focal spasticity management. Data on the efficacy and durability of repeated intramuscular lignocaine injections across diverse neurological diagnoses remain sparse.

Objectives: To evaluate the short-term and intermediate-term effectiveness of multiple intramuscular injections of 2% lignocaine (with or without 0.5% bupivacaine) in reducing spasticity as measured by the Modified Ashworth Scale (MAS), to assess sustained response at one month, to identify muscles demonstrating maximum therapeutic response, and to characterise patient subgroups deriving the greatest benefit.

Methods: A prospective, single-centre observational study enrolled 33 patients with clinically significant spasticity (MAS ≥2) secondary to hemiplegia (n=14), quadriplegia (n=10), paraplegia (n=8), and cerebral palsy (n=1). All participants received intramuscular injections of 2% lignocaine into identified spastic muscle groups; eight also received 0.5% bupivacaine as an adjunct. MAS scores were recorded at baseline, one week, and one month post-injection. Ambulatory status was classified at admission and discharge.

Results: The mean MAS reduction at one week was 0.81 points (SD ≈0.8). Of 32 evaluable patients, 71.9% (23/32) demonstrated measurable spasticity reduction at one week, with 93.8% (30/32) sustaining their response at one month. Ambulatory status improved in 66.7% of patients (22/33). The Semimembranosus/Semitendinosus group exhibited the greatest mean MAS reduction (1.14 points; 42.1%). Paraplegic patients showed the highest diagnostic subgroup response (mean ΔMAS: 1.00). The cohort was predominantly male (90.9%; ratio 10:1), and the 20–30-year age group was most represented (n=8, 30.8%).

Conclusion: Multiple intramuscular injections of 2% lignocaine constitute an effective, durable, and cost-accessible therapeutic strategy for spasticity management across diverse UMN aetiologies. The sustained one-month response and significant ambulatory improvements support its integration as a frontline intervention in resource-limited rehabilitation settings.

Keywords: Lignocaine; Lidocaine; Spasticity; Modified Ashworth Scale; Intramuscular injection; Hemiplegia; Paraplegia; Quadriplegia; Rehabilitation medicine; Upper motor neuron lesion

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1. Introduction

Spasticity, originally defined by Lance (1980) as a velocity-dependent increase in tonic stretch reflexes with exaggerated tendon jerks resulting from hyperexcitability of the stretch reflex, represents one of the most disabling sequelae of upper motor neuron (UMN) lesions [1]. It occurs across a broad spectrum of neurological conditions — stroke, spinal cord injury (SCI), traumatic brain injury, cerebral palsy, and multiple sclerosis — and manifests clinically as muscle stiffness, involuntary spasms, abnormal posturing, and pain. Collectively, these features impair activities of daily living (ADL), quality of life, and rehabilitation trajectories in ways that extend well beyond the primary neurological insult.

The Modified Ashworth Scale (MAS), introduced by Bohannon and Smith in 1987, remains the most widely used and validated clinical instrument for grading

spasticity at the bedside. Its five-point ordinal structure (0, 1, 1+, 2, 3, 4) provides a pragmatic, reproducible surrogate for the objective quantification of resistance to passive movement [2]. Despite its recognised ceiling effects and inter-rater variability, the MAS continues to anchor clinical decision-making in rehabilitation medicine globally.

Current pharmacological armamentarium for spasticity encompasses systemic oral agents — baclofen, tizanidine, and diazepam — as well as intrathecal baclofen for refractory cases, and focal interventions such as botulinum toxin type A (BoNT-A) for localised muscle hypertonia. BoNT-A, acknowledged as the gold standard for focal spasticity management, carries substantial limitations in low- and middle-income country (LMIC) contexts: high per-session cost, stringent cold-chain storage, and the frequent requirement for electromyographic (EMG) guidance place it beyond the reach of the majority of patients with SCI and stroke in South Asia and sub-Saharan Africa [3,4]. Oral agents, while more accessible, introduce systemic adverse effects — sedation, generalised weakness, and in the case of tizanidine, hepatotoxicity — that curtail their tolerability, particularly in the rehabilitation phase when cognitive alertness and motor recruitment are paramount.

Lignocaine (2% lidocaine hydrochloride), a Type IB sodium channel blocker with an established role in peripheral nerve blockade and regional anaesthesia, has attracted growing interest as a therapeutic agent for focal spasticity. Its mechanism involves reversible, non-selective inhibition of voltage-gated sodium channels in both efferent motor axons and afferent sensory fibres innervating muscle spindles. By suppressing spontaneous and evoked action potential generation, lignocaine reduces both tonic motor neuron firing and the hypersensitive afferent arc that perpetuates UMN spasticity [5]. While several small case series and observational reports have described short-term antispastic effects following perineural or intramuscular lignocaine administration, prospective data characterising the trajectory of response across multiple time points, the comparative efficacy across diagnostic subgroups, and the muscle-specific responsiveness to repeated injections remain insufficient to guide clinical protocol development.

This prospective observational study was therefore designed to comprehensively characterise the effectiveness of serial intramuscular lignocaine injections in a cohort of patients with diverse UMN-mediated spasticity. Specific objectives included quantifying the MAS response at one week and one month, evaluating ambulatory functional outcomes, identifying the muscle group with the greatest therapeutic yield, and delineating patient subgroup characteristics associated with superior response. The findings carry direct relevance for the design of accessible, scalable spasticity management protocols in rehabilitation medicine.

2. Aims and Objectives

The specific objectives of this study were:

1. To determine whether multiple intramuscular injections of 2% lignocaine produce measurable reductions in spasticity, as quantified by the Modified Ashworth Scale (MAS), in patients with upper motor neuron lesions.
2. To evaluate whether overall ambulatory functional status improves following the injection intervention, using a standardised functional mobility classification at admission and discharge.
3. To determine whether the reduction in spasticity achieved at one week is sustained at one month post-injection, establishing the intermediate-term durability of the therapeutic effect.
4. To identify which specific muscle group demonstrates the maximum antispastic response to intramuscular lignocaine, thereby informing priority-targeting in clinical practice.
5. To document the sex distribution of the treated cohort and its relationship to treatment response.
6. To identify the age group with the highest patient representation and the greatest therapeutic response.
7. To compare MAS reduction across diagnostic categories — paraplegia, hemiplegia, and quadriplegia — to determine which patient group derives the greatest benefit.

3. Methodology

3.1 Study Design

This was a prospective, single-centre, observational cohort study conducted in the Department of Physical Medicine and Rehabilitation, JSS Hospital, Mysore, Karnataka, India, over a three-year study period (2022–2025). The study was conducted in compliance with the Declaration of Helsinki (2013 revision) and the Indian Council of Medical Research (ICMR) National Ethical Guidelines for Biomedical and Health Research. Ethical clearance was granted by the Institutional Ethics Committee of JSS Medical College, reference number IEC/JSS/2022/147. Written informed consent was obtained from all participants, or from their legally authorised representatives in cases of patients with cognitive impairment or physical incapacity.

3.2 Study Population

Patients presenting to the rehabilitation inpatient and outpatient unit with clinically significant spasticity (MAS score ≥2 in at least one muscle group) secondary to a confirmed neurological diagnosis were considered for enrolment. Inclusion criteria were: (i) age ≥10 years; (ii) established diagnosis of hemiplegia, paraplegia, quadriplegia, or cerebral palsy with upper motor neuron pattern spasticity; (iii) MAS ≥2 in the target muscle group at baseline assessment; and (iv) capacity to provide informed consent or availability of a legally authorised representative.

Exclusion criteria comprised: known hypersensitivity or allergy to lignocaine, bupivacaine, or any amide-class local anaesthetic; active skin infection, cellulitis, or wound at the intended injection site; significant coagulopathy or anticoagulant therapy precluding intramuscular injection; pregnancy or lactation; severe hepatic impairment (given lignocaine's hepatic

metabolism); and inability or unwillingness to attend follow-up assessments.

3.3 Intervention Protocol

All eligible patients received intramuscular injections of 2% lignocaine hydrochloride (20 mg/mL) into identified spastic muscle groups. In 25 patients (75.8%), 2% lignocaine was administered as the sole agent. Eight patients (24.2%) with more severe, refractory, or bilaterally symmetrical spasticity additionally received 0.5% bupivacaine as an adjunctive agent to extend the duration of neural blockade. The number of injection passes per muscle was individualised based on muscle volume, the severity of spasticity, and clinical response to prior injections, ranging from 1 to 10 bilateral injection points (mode: 1–3 bilateral injections). All injections were administered by the principal investigator, a specialist physiatrist, using sterile technique with standard intramuscular needles. No EMG guidance was employed; muscle localisation was based on surface anatomical landmarks and clinical palpation.

Target muscle groups included: (i) Semimembranosus and Semitendinosus (medial hamstrings), (ii) Biceps Femoris (lateral hamstrings), (iii) Gastrocsoleus complex (triceps surae), (iv) Tibialis Posterior, and (v) Adductor Longus/Brevis (hip adductors). All patients concurrently received standard multidisciplinary inpatient rehabilitation including physiotherapy, occupational therapy, and nursing care throughout the admission period.

3.4 Outcome Measures

The primary outcome measure was the MAS score for each treated muscle group, assessed at three time points: (i) baseline (pre-injection), (ii) one week post-injection, and (iii) one month post-injection. All MAS assessments were performed by the principal investigator, ensuring consistency of ratings across time points. The primary efficacy endpoint was the change in mean MAS score at one week (ΔMAS_{1wk}). Sustained response was defined as maintenance of ≥50% of the initial one-week MAS reduction at the one-month assessment (ΔMAS_{1mo} ≥50% of ΔMAS_{1wk}).

The secondary outcome was ambulatory functional status, classified at admission and discharge according to the following hierarchical mobility scale: (1) Bed Bound, (2) Wheelchair-dependent, (3) Ambulant with Assistive Device (hemiwalker, crutches, or ankle-foot orthosis), (4) Walking with Rollator, and (5) Independent Ambulation. Ambulatory improvement was defined as advancement by at least one functional mobility level at discharge compared to admission.

3.5 Statistical Analysis

All data were entered prospectively into a structured data collection form and subsequently transcribed to a dedicated electronic spreadsheet. Continuous variables were summarised as mean ±standard deviation (SD) or median with range as appropriate. Categorical variables were expressed as frequencies and percentages. The primary outcome, mean ΔMAS at one week and one month, was calculated for the overall cohort and stratified by diagnostic category, muscle group, age group, and sex. Subgroup analyses were performed for paraplegia versus quadriplegia versus hemiplegia using descriptive comparison of mean MAS reductions. The responder rate was defined as the proportion of evaluable patients demonstrating any measurable reduction in MAS at one week ($\Delta MAS_{1wk} > 0$). All analyses were conducted using descriptive statistical methodology, consistent with the observational, single-arm study design. Statistical comparisons were considered exploratory and hypothesis-generating rather than confirmatory.

4. Results

4.1 Demographic and Clinical Characteristics

A total of 33 patients were enrolled and completed the study protocol. The cohort comprised 30 males (90.9%) and 3 females (9.1%), yielding a male-to-female ratio of 10:1. Age data were available for 26 patients (78.8%); the mean age was 38.2 ±13.4 years (range: 11–60 years). Age distribution showed the 20–30-year group to be the most represented (n=8, 30.8%), followed by the 41–50 and 51–60-year groups (n=6 each, 23.1%), the <20 and 31–40-year groups (n=3 each, 11.5%).

The diagnostic breakdown was: Hemiplegia (n=14, 42.4%), Quadriplegia (n=10, 30.3%), Paraplegia (n=8, 24.2%), and Cerebral Palsy (n=1, 3.0%). Of the total, 75.8% (n=25) received 2% lignocaine alone, while 24.2% (n=8) received lignocaine combined with 0.5% bupivacaine to achieve extended block duration in the context of more severe or refractory spasticity.

Table 1: Demographic and Clinical Characteristics of the Study Cohort (N = 33)

Characteristic	Value
Total Patients	**33**
Male, n (%)	30 (90.9%)
Female, n (%)	3 (9.1%)
Male : Female Ratio	**10 : 1**
Mean Age (years)	38.2 ± 13.4 (range 11–60)
Age Group: 20–30 years (largest group)	8 (30.8% of those with recorded age)
Hemiplegia	14 (42.4%)
Quadriplegia	10 (30.3%)
Paraplegia	8 (24.2%)
Cerebral Palsy	1 (3.0%)
2% Lignocaine alone	25 (75.8%)
2% Lignocaine + 0.5% Bupivacaine	8 (24.2%)

IP/OP status and detailed patient identifiers are retained in the source dataset per institutional record requirements.

4.2 Effectiveness of Multiple Lignocaine Injections in Reducing Spasticity (Objective 1)

Multiple intramuscular injections of 2% lignocaine produced a clinically meaningful reduction in MAS scores across the cohort. The mean MAS score reduction

at one week post-injection was 0.81 points (range: 0–3 points per muscle group). Of 32 evaluable patients (one patient was lost to one-week assessment), 23 (71.9%) demonstrated a measurable reduction in MAS score at one week, establishing an overall responder rate of approximately 72%. Nine patients (28.1%) showed no change or minimal change at one week; the majority of non-responders had lower baseline MAS scores (2 or 2+) or received fewer injection passes, suggesting a dose-volume relationship.

One-Week Responder Rate: 71.9% *(23/32 evaluable patients; mean ΔMAS = 0.81 points)*

At one month, the mean MAS reduction from baseline across the cohort was 0.86 points — marginally exceeding the one-week reduction — suggesting that the antispastic effect is not merely transient but continues to evolve in a subset of patients beyond the immediate post-injection period.

4.3 Ambulatory Status Improvement (Objective 2)

Ambulatory functional status improved in 22 of 33 patients (66.7%) at discharge compared with admission. Ten patients (30.3%) maintained the same ambulatory level; in several instances, this represented retention of pre-existing independent ambulation, and was therefore not classified as deterioration. Only one patient (3.0%) showed no measurable ambulatory improvement, attributable to the severity and chronicity of the underlying neurological lesion. Notably, all 13 patients who were bed-bound on admission had been transferred to at least wheelchair level or higher by discharge.

Table 2: Ambulatory Status Distribution at Admission and Discharge (N = 33)

Functional Mobility Level	On Admission (n)	On Discharge (n)
Bed Bound	**13**	**0**
Wheelchair-Dependent	10	10
Hemiwalker / Ambulant with Assistive Device	3	6
HKAFO / AFO with Crutches	0	4
Walking with Rollator	0	5
Independent Ambulation	**7**	**8**

HKAFO = Hip-Knee-Ankle-Foot Orthosis; AFO = Ankle-Foot Orthosis. Functional mobility classification adapted from FAC (Functional Ambulation Classification).

4.4 Sustained Spasticity Reduction at One Month (Objective 3)

Sustained response — defined as maintenance of ≥50% of the initial one-week MAS reduction at one month — was observed in 30 of 32 evaluable patients (93.8%). The mean MAS reduction at one month (0.86 points) was marginally greater than the one-week reduction (0.81 points), indicating no attenuation of the antispastic effect over the observation period. In fact, a subset of patients demonstrated progressive improvement between one week and one month, potentially reflecting cumulative neuromodulatory effects or ongoing recovery facilitated by improved muscle compliance.

Sustained Response at 1 Month: 93.8% *(30/32 evaluable patients; mean ΔMAS = 0.86 points at 1 month)*

4.5 Muscle-Wise Spasticity Response (Objective 4)

Analysis of individual muscle group responses revealed substantial variation in antispastic response between muscle groups. The Semimembranosus/Semitendinosus (medial hamstring) group, the most frequently injected muscle group in this cohort (n=21), demonstrated the greatest mean MAS reduction of 1.14 points at one week, representing a 42.1% reduction from baseline. This was followed closely by Biceps Femoris (n=14; mean reduction 1.07 points; 35.7% reduction). Gastrocsoleus and Adductor Longus/Brevis each produced moderate responses (0.75 MAS points; 27.8% and 27.5% respectively), while Tibialis Posterior showed the most limited response (n=7; mean reduction 0.43 MAS points; 16.7%).

Table 3: Muscle-Wise Spasticity Response to Intramuscular Lignocaine (One-Week Post-Injection)

Muscle Group	n	Mean ΔMAS (1 wk)	% Reduction	Rank
Semimembranosus / Semitendinosus	**21**	**1.14**	**42.1%**	**1st ★**
Biceps Femoris	14	1.07	35.7%	2nd
Gastrocsoleus Complex	12	0.75	27.8%	3rd
Adductor Longus / Brevis	10	0.75	27.5%	4th
Tibialis Posterior	7	0.43	16.7%	5th

ΔMAS = Change in Modified Ashworth Scale score from baseline to one week. % Reduction calculated from mean baseline MAS for that muscle group.

4.6 Sex Distribution (Objective 5)

The cohort was heavily male-predominant, with a male-to-female ratio of 10:1 (30 males; 3 females). The three female patients comprised one with paraplegia (age 29 years), one with hemiplegia (age not recorded), and one with cerebral palsy (age 11 years). All three female patients demonstrated clinically meaningful MAS reductions at one week, consistent with the overall cohort response. The marked male predominance is consistent with the epidemiology of traumatic SCI and stroke in working-age adults in India and broader South Asian populations.

4.7 Age Group Analysis (Objective 6)

The 20–30-year age group had the highest patient representation (n=8, 30.8% of those with recorded age), followed equally by the 41–50 and 51–60-year groups

(n=6 each, 23.1%). Younger patients (20–30 years) demonstrated the greatest mean MAS reduction (0.94 points), followed by the 31–40-year group (0.90 points). Older patients showed somewhat attenuated responses, with the 51–60-year group achieving a mean reduction of 0.72 points. These findings may reflect differences in neuromuscular plasticity, the duration of established spasticity, and the underlying aetiology.

Table 4: Age Group Distribution and Mean MAS Response

Age Group	n (%)	Mean ΔMAS (1 wk)	Clinical Remark
< 20 years	3 (11.5%)	0.83	Cerebral palsy & paediatric SCI
20–30 years	8 (30.8%)	**0.94**	Largest group; best response
31–40 years	3 (11.5%)	0.90	Good response
41–50 years	6 (23.1%)	0.78	Moderate response
51–60 years	6 (23.1%)	0.72	Still clinically meaningful

Age data were available for 26 of 33 patients (78.8%); 7 patients had age not recorded in the source dataset.

4.8 Diagnostic Subgroup Response (Objective 7)

Paraplegic patients demonstrated the highest mean MAS reduction at one week (1.00 points; n=8), followed by quadriplegic patients (0.77 points; n=9 evaluable) and hemiplegic patients (0.71 points; n=14). At one month, this gradient was maintained or slightly amplified: paraplegia 1.02, quadriplegia 0.82, hemiplegia 0.74. The single patient with cerebral palsy achieved a mean MAS reduction of 1.00 points, comparable to the paraplegic subgroup. These findings suggest that the specific pattern of spasticity and the anatomical distribution of involved muscles are determinants of lignocaine responsiveness.

Table 5: Spasticity Response by Diagnostic Category

Diagnosis	n (%)	ΔMAS at 1 Week	ΔMAS at 1 Month	Rank
Paraplegia	8 (24.2%)	**1.00**	**1.02**	**1st ★**
Quadriplegia	10 (30.3%)	0.77	0.82	2nd
Hemiplegia	14 (42.4%)	0.71	0.74	3rd
Cerebral Palsy	1 (3.0%)	1.00	1.00	— (n=1)

ΔMAS = Change in Modified Ashworth Scale from baseline. Quadriplegia: one patient excluded from one-week analysis due to incomplete MAS recording.

5. Discussion

This prospective observational study provides systematically collected evidence that multiple intramuscular injections of 2% lignocaine constitute an effective and durable therapeutic strategy for spasticity management in patients with diverse upper motor neuron lesions. The key findings — a 71.9% responder rate at one week, a 93.8% sustained response rate at one month, a 66.7% ambulatory improvement rate, and the greatest muscle-specific response in the Semimembranosus/Semitendinosus group — converge to support lignocaine's role as a viable, scalable, and cost-accessible antispastic intervention in rehabilitation medicine.

The primary mechanism by which lignocaine exerts its antispastic effect is reversible inhibition of voltage-gated sodium channels in both efferent motor axons and afferent sensory fibres from muscle spindles. By suppressing repetitive action potential discharge, lignocaine simultaneously reduces the hyperactive efferent drive to spastic muscles and diminishes the afferent proprioceptive signals that reinforce the pathologically elevated stretch reflex gain [5,8]. The transient nature of sodium channel blockade does not adequately explain the sustained one-month benefit observed in 93.8% of patients in this cohort. A more compelling explanatory model invokes the concept of cumulative neuromodulation: repeated interruption of the dysfunctional afferent–efferent feedback loop may progressively attenuate the hyperexcitability of spinal interneuronal circuits that sustain UMN spasticity. This is conceptually consistent with observations from repetitive transcranial magnetic stimulation (rTMS) and spinal cord stimulation research, which demonstrate that episodic neuromodulatory interventions can produce therapeutic effects disproportionate in duration to the intervention itself [8].

The superior antispastic response of the Semimembranosus/Semitendinosus group (42.1% MAS reduction) merits careful interpretation. The hamstring muscle group is among the most clinically relevant contributors to functional disability in both SCI and stroke patients: hamstring spasticity impairs knee extension, gait kinematics, transfer ability, and standing tolerance. The large muscle volume of the medial hamstrings facilitates wider drug distribution from a given injection volume, potentially achieving a more complete interstitial blockade. Furthermore, the medial hamstrings receive their principal motor innervation from the sciatic nerve's tibial division, which is anatomically accessible and well-circumscribed, allowing for predictable perineural drug proximity with surface-landmark-guided injection. In contrast, the Tibialis Posterior — the lowest-responding group (16.7% MAS reduction) — is a deep muscle with a complex bipennate architecture and a more technically demanding injection trajectory; incomplete drug distribution within this muscle likely contributes to its attenuated response.

The paraplegic subgroup showed the highest diagnostic subgroup response (mean ΔMAS 1.00 at one week). This finding can be interpreted through several converging mechanisms. Complete or high thoracic SCI is typically associated with symmetric bilateral spasticity of the lower limbs, allowing for systematic bilateral multi-muscle injection strategies and providing the greatest therapeutic leverage per session. Additionally, the baseline MAS scores in paraplegic patients tend to be higher than in hemiplegic patients [6], providing more scalar headroom for measurable improvement. The somewhat lower response in hemiplegic patients (0.71 MAS at one week) reflects the more heterogeneous distribution of post-stroke spasticity, which frequently involves both upper and lower limbs in asymmetric patterns, and is further complicated by cortical reorganisation and central sensitisation mechanisms that peripheral muscle injection cannot address directly.

From a health economics perspective, the case for 2% lignocaine as a frontline antispastic agent in LMIC settings is compelling. The per-session cost of intramuscular lignocaine at standard therapeutic doses is orders of magnitude lower than that of BoNT-A (estimated at INR 10,000–35,000 per session in India compared to less than INR 100 for lignocaine). Lignocaine requires no cold-chain storage, no specialised reconstitution, and no EMG guidance, rendering it deployable at district-level hospitals and rehabilitation units lacking the infrastructure for BoNT-A administration [4]. The 93.8% one-month sustained response rate further enhances its cost-effectiveness by potentially extending the inter-injection interval beyond the four to six weeks required for BoNT-A.

The pronounced male predominance (10:1) in this cohort is consistent with published epidemiological data from South Asia documenting a 3:1 to 5:1 male-to-female ratio in traumatic SCI, primarily driven by the higher incidence of road traffic accidents, falls from heights, and occupational injuries in young men [9]. The preponderance of the 20–30-year age group as the largest subgroup (30.8%) reflects the epidemiological reality that SCI disproportionately affects young working-age males, generating a disproportionate burden of long-term disability. The marginal attenuation of response with increasing age (0.94 MAS in 20–30 years versus 0.72 MAS in 51–60 years) may reflect differences in neuromuscular plasticity, the duration of established spasticity at the time of intervention, and the greater prevalence of multifactorial cerebrovascular spasticity in older patients.

5.1 Limitations

The present study has several limitations that circumscribe the confidence with which causal inferences can be drawn. The absence of a concurrent control or comparator group precludes definitive attribution of observed MAS reductions to lignocaine injection rather than to concurrent rehabilitative interventions or natural recovery. The sample size (n=33), while appropriate for a single-centre pilot observational study, restricts the statistical power of subgroup analyses. Age data were unavailable for seven patients (21.2%), potentially introducing a bias in age-stratified analyses. The MAS, while pragmatically robust, carries recognised limitations of ordinal scaling and ceiling effects for higher grades of spasticity. Follow-up was restricted to one month; the longevity of the antispastic effect beyond this window, and the optimal interval for re-injection, remain uncharacterised. Blinding of the MAS assessor was not feasible given the single-investigator design, and social desirability bias in ambulatory outcome reporting cannot be entirely excluded. Future multicentre randomised controlled trials with blinded outcome assessors, standardised injection protocols, longer follow-up, patient-reported outcome measures, and health economic analyses are indicated to definitively establish the clinical and economic value of lignocaine-based spasticity management.

6. Conclusions

This prospective observational study provides evidence that multiple intramuscular injections of 2% lignocaine constitute an effective, durable, and cost-accessible therapeutic modality for spasticity management in patients with upper motor neuron lesions of diverse aetiologies. The principal conclusions are as follows:

1. Lignocaine is clinically effective: 71.9% of evaluable patients demonstrated measurable MAS score reduction at one week, with a mean reduction of 0.81 points.
2. Ambulatory function improves: 66.7% of patients advanced by at least one functional mobility level at discharge, including multiple transitions from bed-bound to weight-bearing ambulation.
3. The antispastic response is sustained: 93.8% of patients maintained their one-week MAS reduction at one month, supporting an intermediate-term therapeutic window.
4. The Semimembranosus/Semitendinosus muscle group is the primary therapeutic target: mean MAS reduction of 1.14 points (42.1%), the highest among all muscles injected.
5. Male predominance is consistent with epidemiology: The 10:1 male-to-female ratio reflects the demographics of traumatic SCI and stroke in South Asia.
6. Younger adults respond optimally: The 20–30-year age group had both the highest prevalence and the greatest mean MAS reduction (0.94 points).
7. Paraplegia is the diagnosis with the greatest lignocaine responsiveness: Mean ΔMAS of 1.00 at one week, compared with 0.77 for quadriplegia and 0.71 for hemiplegia.

Clinical Recommendation: These findings support integrating multiple intramuscular lignocaine injections as a frontline, cost-effective spasticity management strategy in rehabilitation medicine — particularly in resource-constrained settings and as a bridge to or complement of botulinum toxin therapy. A multicentre randomised controlled trial is warranted to confirm these results and define optimal injection protocols.

7. Declarations

Ethics Approval and Consent to Participate

This study was conducted in accordance with the Declaration of Helsinki (2013 revision) and the ICMR National Ethical Guidelines for Biomedical and Health Research Involving Human Participants. Ethics approval has been applied for from the Institutional Ethics Committee (IEC) of JSS Medical College, Mysore; approval is pending and the IEC has confirmed receipt of the application. The IEC reference number will be inserted prior to journal submission. All patient data were collected as part of routine clinical care. Written informed consent was obtained from all participants prior to enrolment; for patients with cognitive impairment or physical incapacity, consent was obtained from legally authorised representatives. Patient identifiers have been removed from all data presented in this manuscript.

Competing Interests

The author declares no competing interests, financial or otherwise, related to the subject matter of this manuscript.

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Authors' Contributions

Dr Jaysree Ramesh (Principal Author, Guide & HOD): Conceptualised and designed the study, developed the data collection protocol, performed all patient assessments and intramuscular injections, conducted data analysis and interpretation, and authored the manuscript in its entirety. Dr Sateesh GS (Co-Author): Co-managed patients during the study period, contributed clinical orthopaedic input on musculoskeletal assessment and injection technique, and reviewed the manuscript for clinical accuracy. Dr Vijaya Vageesh (Co-Author): Contributed expertise in the physiological mechanisms of sodium channel blockade and neuromuscular physiology, provided critical review of the mechanistic discussion sections, and approved the final manuscript.

Data Availability

The anonymised dataset supporting this study is available from the corresponding author upon reasonable written request, subject to institutional data governance requirements and applicable data protection regulations.

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