

Original Article

Comparative Efficacy of Electro-Acupuncture, Lignocaine, and Their Combination for Digital Nerve Analgesia in Equines

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Conflict of Interest: None.

Rahman IU, et al. (2024). 4(1): DOI: <https://doi.org/10.61919/jhrr.v4i1.576>

ABSTRACT

Background: As Traditional Chinese Veterinary Medicine (TCVM) evolves, its application in equine lameness and pain diagnosis is gaining prominence. Accurate identification of pain sites is crucial for addressing equine leg issues, necessitating the use of local analgesics through digital nerve blocks (DNB). This study explores the efficacy of lignocaine and electro-acupuncture (EA), individually and combined, in providing analgesia following DNB in Equines with minimal complications.

Objective: The primary aim was to assess and compare the analgesic effects of lignocaine and electro-acupuncture, alone and in combination, following digital nerve blocks in Equines.

Methods: Twenty-four healthy adult donkeys were divided into four groups (n=6 each): Group A (control, receiving 0.9% NaCl), Group B (lignocaine 1.5 ml), Group C (EA alone), and Group D (0.75 ml lignocaine + EA). The degree of analgesia (DOA) was evaluated at intervals (5, 10, 15, 20, 30, 45, 60, 90, 120, and 180 minutes) post-treatment.

Results: Lignocaine (Group B) showed a higher degree of analgesia at early intervals (0.67 ± 0.21 at 5 min, 0.83 ± 0.17 at 10 min, 1.67 ± 0.21 at 15 min, 2.50 ± 0.34 at 20 min, 2.7 ± 0.21 at 30 min, and 3.0 ± 0.00 at 45 min), significantly surpassing other groups. Group D, treated with lignocaine and EA, exhibited superior long-term analgesia (3.0 ± 0.0 at 60 and 90 min, 2.33 ± 0.21 at 120 min, and 0.83 ± 0.16 at 180 min), indicating sustained efficacy over time.

Conclusion: Combining lignocaine with electro-acupuncture enhances the quality and duration of analgesia following digital nerve blocks in Equines. This approach minimizes the need for higher drug dosages and reduces the risk of complications, suggesting a viable option for pain management in equine medicine.

Keywords: Digital nerve blocks (DNB), Equines, Electro-acupuncture (EA), Lignocaine, Pain management, Traditional Chinese Veterinary Medicine (TCVM), Analgesic efficacy, Veterinary anesthesia, Comparative medicine

INTRODUCTION

The integration of Traditional Chinese Veterinary Medicine (TCVM), particularly acupuncture, into equine healthcare has gained noticeable traction within scientific circles, chiefly for managing musculoskeletal conditions in horses. A pivotal survey underscored acupuncture's prevalence as a reason for veterinary referrals, highlighting the modality's positive reception among horse owners(1). Acupuncture, traditionally esteemed for its therapeutic potential, has found a complementary role in veterinary medicine, addressing chronic pain, inflammation, and systemic disorders, including equine laminitis(2).

Electro-acupuncture (EA), an advanced form of acupuncture where electric currents enhance needle stimulation at acupoints, has shown promise when used alongside traditional acupuncture treatments(3). A noteworthy portion of practitioners in equine veterinary practices have adopted electro-acupuncture, with a survey revealing that 33% incorporate this modality in rehabilitation protocols (4). The synergy between electro-acupuncture and anti-nociceptors has been especially beneficial during surgeries, not only enhancing antinociceptive effects but also reducing the adverse outcomes associated with analgesic drugs(5, 6). This combination therapy has been shown to decrease the requisite dosages of analgesics across several species including humans, rats, and goats (7).

In the realm of anaesthesia, digital block anaesthesia emerges as a commonly utilized method by healthcare providers across various medical disciplines. Research has validated the effectiveness and safety of local anaesthesia via digital blocks(6). Agents such as 2% lidocaine, and 0.5% to 0.75% ropivacaine, among others, have been employed for diagnostic anaesthesia in horses, with 1% lidocaine without epinephrine often preferred for its efficacy in pain localization during lameness examinations, offering effective anaesthesia for up to three hours(8-11). Such duration is particularly advantageous for initial perineural blocks to identify pain regions more precisely (12).

Stimulation of acupoints has been shown to block pain by releasing endogenous opioids and neurotransmitters(13), and acupuncture has been extensively applied to treat several neurological disorders due to its minimal post-treatment complications (14). While lignocaine provides quality analgesia and can ameliorate lower leg issues in equines, it falls short in addressing lameness (11, 15). This study, therefore, aimed to evaluate the antinociceptive efficacy of electroacupuncture and lignocaine, both separately and in combination, following digital nerve analgesia in Equines, addressing a gap in the literature concerning the comparative effectiveness of these treatments in equine analgesia.

This study's findings on the combined use of electro-acupuncture (EA) and lignocaine for digital nerve analgesia in Equines offer intriguing implications for human health sciences, particularly in the realm of pain management and anaesthesia. By demonstrating the efficacy of integrating traditional acupuncture techniques with modern pharmacological approaches, this research provides a compelling case for the potential benefits of similar multimodal pain management strategies in humans. The reduced need for higher drug dosages and the subsequent decrease in the risk of complications highlight a promising approach to addressing chronic pain and improving surgical anaesthesia. Additionally, the insights gained from the analgesic mechanisms of EA could inform the development of non-pharmacological interventions in humans, offering alternatives or complements to traditional pain management strategies. This could lead to more personalized and holistic treatment plans, aligning with the growing interest in integrative medicine that combines the best of conventional and alternative therapies for optimal health outcomes.

MATERIAL AND METHODS

In this study, twenty-four healthy adult donkeys, aged between 1.5 to 2 years and weighing between 90 to 130 kg, were selected to evaluate the analgesic effects of 2% lignocaine and electro-acupuncture, both alone and in combination. These donkeys, sourced from the local vicinities of Tando-Jam and Peshawar, were systematically divided into four groups, with six animals per group. To ensure their well-being, they were kept in optimal environmental conditions, with feed and water provided ad libitum. However, food was withheld for 12 hours prior to the commencement of the experiment to prepare them for the treatments. The ethical approval for this research was granted during the 152nd meeting of the Department of Surgery and Obstetrics and the Directorate of Advanced Studies and Research (DASAR) at the Sindh Agriculture University Tando-Jam.

The experimental design was meticulously planned to administer four treatments to each group: a saline solution (0.9% NaCl) at 0.04 mL/kg as the control, electro-acupuncture, a single dose of 2% lignocaine (1.5 mL), and a combination of electro-acupuncture with lignocaine (0.75 mL, intramuscularly). All intramuscular injections were carefully given in the web space adjacent to the metacarpal head, following the precise localization of the digital nerve on both the lateral and medial sides of the forelimb, below the distal end of the metacarpal bone, where the digital artery and vein are also located (16). The electro-acupuncture treatment utilized stainless steel needles, delivering electric pulses to selected acupuncture points. These treatments were synchronized to ensure that all donkeys receiving electro-acupuncture, lignocaine, or their combination were treated simultaneously. The onset times for observable antinociceptive effects varied across groups, with Group B experiencing induction times between 5 to 7 minutes, Group C between 15 to 20 minutes, and Group D between 10 to 15 minutes, in contrast to the control group.

Preparation for electro-acupuncture involved shaving and disinfecting the selected acupuncture sites with a 10% povidone-iodine solution. Sterilized needles were then inserted into predetermined points by a skilled acupuncturist. The chosen acupoints included TH-1 (Qian-ti-tou "Thoracic Hoof Toe"), PC-9 (Qian-jiu "Thoracic Entral Bulb"), and LU-11 (Shao-Shong), based on their relevance to the study's objectives (17, 18). Diagnostic acupuncture palpation preceded each treatment session to ensure the accurate selection and insertion of needles to a depth of 0.5 cun (approximately 16.66 mm). Electrodes attached to the needles facilitated the delivery of a mild electrical current, enhancing the stimulation at the acupoints. The electro-acupuncture settings were maintained at a frequency of 60 Hz and an intensity of 3.2 V for 60 minutes, after which the settings were returned to zero, and the equipment was disconnected and removed (19, 20).

The effectiveness of digital nerve analgesia was evaluated in the four groups, labeled A, B, C, and D, following treatments with 2% lignocaine and electro-acupuncture, both alone and in combination. The assessment times post-treatment were at 5, 10, 15, 20, 30, 45, 60, 90, 120, and 180 minutes. Analgesia was assessed by inducing a needle punch and grading the response using the Bromage scale, with scores ranging from 0 (no block) to 3 (complete block), indicating the degree of analgesia achieved (21).

For statistical analysis, data were processed using MS 365 Excel (2010) and the Statistical Software Statistic V-8.1 (2008). A significance threshold was set at $P < 0.05$, employing the least significant difference method (LSD) to determine the effectiveness of the treatments. This approach ensured a rigorous evaluation of the analgesic efficacy of electro-acupuncture and lignocaine, providing valuable insights into their potential as analgesic agents in veterinary medicine.

RESULTS

The clinical evaluation of analgesia revealed varying degrees of pain relief among the groups, as measured by mean and standard error values (Mean \pm S.E) over several time intervals. Initially, in the 5-10 minute interval, Group B, treated with lignocaine alone, demonstrated rapid onset of analgesia (0.67 ± 0.21 & 0.83 ± 0.17), marking a highly significant difference ($P < 0.001$) compared to Groups A, C, and D. By the 15-minute mark, Group B reached peak analgesic effect (1.67 ± 0.21), significantly outperforming ($P < 0.001$) the rest, with Group D, treated with a combination of lignocaine and electro-acupuncture, closely following (1.45 ± 0.21).

At 20 minutes, the analgesic efficacy in Group B was most pronounced (2.50 ± 0.34), significantly higher ($P < 0.001$) than in the other groups, with Group D again being the next most effective (1.67 ± 0.16). Thirty minutes into the treatment, Group B maintained the lead in analgesic effect (2.7 ± 0.21), with Group D not far behind (2.45 ± 0.21), both showing significant superiority ($P < 0.001$) over Groups A and C.

By the 45-minute interval, the highest level of pain relief was observed in Group B (3.0 ± 0.0), followed closely by Group D (2.72 ± 0.23), both significantly surpassing ($P < 0.001$) Groups A and C. Sixty minutes into the treatment, Group D achieved a perfect analgesic score (3.0 ± 0.0), indicating full analgesia, a significant improvement ($P < 0.001$) over Group B, which noted a slight reduction in effectiveness (2.5 ± 0.22).

Ninety minutes post-treatment, Group D maintained full analgesia (3.0 ± 0.0), significantly outperforming ($P < 0.001$) Group B, which experienced a decrease in pain relief (1.7 ± 0.21). At the 120-minute mark, pain relief remained highest in Group D (2.33 ± 0.21), which was significantly better ($P < 0.002$) than the other groups, A, B, and C. Finally, at 180 minutes, only Group D sustained a level of analgesia (0.83 ± 0.16) that was significantly higher ($P < 0.001$) than that of the other groups.

This analysis highlights the differential impact of lignocaine and electro-acupuncture, both alone and in combination, on the duration and effectiveness of analgesia in Equines.



Figure 1: It showed that (A) digital nerve block site, (B) needle punching to observe the pain relief or degree of analgesia and (C & D) electro-acupuncture treatment in donkeys.

DISCUSSION

This study, sanctioned by the departmental board and undertaken on twenty-four healthy donkeys, set out to assess the analgesic efficacy of 2% lignocaine and electro-acupuncture, both singularly and in a reduced-dose combination. The allocation of donkeys into groups A (saline control), B (lignocaine alone), C (electro-acupuncture alone), and D (a half-dose of lignocaine combined with electro-acupuncture) facilitated a comprehensive evaluation. The findings substantiated the hypothesis that a reduced lignocaine

dose, when used in conjunction with electro-acupuncture for digital nerve block analgesia, yields significantly superior results up to 120 minutes, potentially covering the duration of many surgical procedures.

The early onset of analgesia within five to ten minutes predominantly in group B mirrors previous research, such as Schumacher et al. (2013) and Miller et al. (2014), emphasizing the rapid action of lignocaine but also its relatively short-lived effect. Consistent with Silva et al. (2015) and Da Silva et al. (2010), the results highlighted a peak in lignocaine's analgesic effect around 15 to 20 minutes post-administration. This pattern supports the conventional understanding of lignocaine's pharmacodynamics, suggesting an optimal window for surgical intervention shortly after administration(11, 22-24).

Interestingly, the sustained analgesic efficacy observed in group D (lignocaine combined with electro-acupuncture) at 60, 90, and 120 minutes not only corroborates with findings from Han (2004) and Sheta et al. (2015) but also marks a significant advancement in pain management strategies. This sustained analgesia underscores the potential synergistic effect of combining pharmacological and non-pharmacological treatments, enhancing analgesic duration without necessitating higher doses of drugs(21, 25).

A notable strength of this study is its methodological rigor and the clear delineation of treatment effects across different time intervals, providing a nuanced understanding of analgesic dynamics in a veterinary context. However, limitations are present, including the relatively small sample size and the focus on donkeys, which might limit the generalizability of the findings to other equine species or animals. Additionally, the study did not explore the physiological mechanisms underpinning the observed synergistic effects, leaving room for further research in this area.

The investigation enriches the current literature on veterinary analgesia, especially in the context of combining electro-acupuncture with traditional local anesthetics. The results advocate for a more integrative approach to pain management in veterinary medicine, suggesting that such combinations could optimize analgesic outcomes while potentially mitigating drug-related adverse effects. Future studies could expand on these findings by exploring the underlying mechanisms of action, evaluating long-term outcomes, and assessing applicability across a broader spectrum of veterinary patients.

CONCLUSION

The study conclusively demonstrates that the combination of 2% lignocaine with electro-acupuncture significantly enhances the quality and duration of nerve block analgesia for pain relief procedures in Equines, without adverse effects such as neuritis, loss of sensation, or laminitis. Minor side effects were observed but at a negligible level. This synergistic approach not only offers superior analgesia but also reduces the necessity for higher drug dosages, thereby minimizing potential stress and infection risks associated with surgical interventions. Such findings suggest a promising avenue for improving pain management strategies in veterinary practice, particularly for conditions like chronic laminitis and during surgical procedures, by integrating traditional pharmacological methods with electro-acupuncture to optimize animal care and rehabilitation outcomes.

Additionally, the success of combining electro-acupuncture with lignocaine in this study offers meaningful implications for human health, suggesting a potential for innovative, low-risk pain management and anesthesia strategies. The cross-species applicability of these findings highlights a pathway for developing holistic, efficient treatment methods that could revolutionize both veterinary and human medical practices.

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