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Evaluation of Anti-Inflammatory and Analgesic Activities of Dexibuprofen in Albino Rats: An Experimental Study

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Abstract

Background: Inflammatory conditions are characterized by the production of prostaglandins, which are synthesized by the enzyme cyclooxygenase (COX). COX-2, an inducible isoform, is primarily responsible for prostaglandin production during inflammation. **Objectives:** This study aimed to assess the anti-inflammatory and analgesic properties of a dexibuprofen, in albino rats. **Methods:** The anti-inflammatory and analgesic properties of dexibuprofen were assessed using two animal models: the carrageenan-induced paw edema model, which measures paw volume as an indicator of inflammation, and the acetic acid-induced writhing model, which quantifies writhing as a measure of pain response in rats.**Results:** Treatment with dexibuprofen, , significantly reduced paw volume in the carrageenan-induced paw edema model compared to the control group. The anti-inflammatory effect of dexibuprofen was comparable to that of the standard NSAID. Moreover, dexibuprofen significantly reduced the number of writhes in the acetic acid-induced writhing model, demonstrating an analgesic effect similar to the standard NSAID. **Conclusion:** Dexibuprofen, exhibited potent anti-inflammatory and analgesic properties in animal models of inflammation and pain. These results suggest that dexibuprofen may hold therapeutic potential for the treatment of inflammatory and painful conditions.

Keywords: Inflammatory response, pain relief, animal experimentation, prostaglandin synthesis, nonsteroidal anti-inflammatory agents

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INTRODUCTION

Inflammatory conditions pose a significant burden on global health, contributing to high rates of morbidity and mortality. Diseases such as rheumatoid arthritis, osteoarthritis, inflammatory bowel disease, and cardiovascular disease are closely associated with chronic inflammation[1]. The inflammatory response is a complex biological process involving the activation of immune cells and the release of various mediators, including prostaglandins[2].

Prostaglandins, synthesized by the enzyme cyclooxygenase (COX), play a pivotal role in the inflammatory cascade. There are two isoforms of COX: COX-1 and COX-2. COX-1 is constitutively expressed in most tissues and is involved in maintaining normal physiological functions. On the other hand, COX-2 is inducible and is primarily responsible for prostaglandin production during inflammatory conditions[3,4].

Nonsteroidal anti-inflammatory drugs (NSAIDs), such as aspirin and ibuprofen, are widely used to alleviate inflammation by inhibiting COX enzyme activity and subsequently reducing prostaglandin synthesis[5]. However, the use of NSAIDs is associated with a range of adverse effects, particularly in the gastrointestinal system, including peptic ulceration, gastrointestinal bleeding, and perforation[6,7,8].

In this study, our objective was to evaluate the anti-inflammatory and analgesic properties of dexibuprofen, in animal models of inflammation. Our aim was to assess whether dexibuprofen could serve as a therapeutic agent for the treatment of inflammatory and painful conditions while minimizing adverse effects. To test the efficacy of dexibuprofen, we employed various well-established animal models of inflammation and pain, including the carrageenan-induced paw edema model in rats and the acetic acid-induced writhing model in rats.

Through the use of these animal models, we sought to investigate the potential of dexibuprofen in mitigating inflammation and providing pain relief. The results of this study may contribute to a better understanding of the therapeutic potential of dexibuprofen and aid in the development of safer and more effective treatments for inflammatory and painful conditions. Furthermore, this research may provide insights into the mechanism of action and the role of COX-2 in inflammation and pain pathways, leading to advancements in the field of anti-inflammatory drug development.

MATERIALS & METHODS

Study Location and Experimental Animals: The study was conducted at , Mallareddy Medical College for Women, Suraram, Hyderabad, Telangana, India. Male albino rats weighing 200-250 g were used for the animal experiments. The animals were housed in a controlled environment with ad libitum access to food and water. All animal procedures were carried out following the guidelines set forth by the Institutional Animal Care and Use Committee.

Experimental Design: To assess the anti-inflammatory properties of the dexibuprofen the carrageenan-induced paw edema model[9] was employed. The rats were randomly divided into three groups, with six rats per group. The groups received one of the following: dexibuprofen (at a dose of 10 mg/kg), a standard nonsteroidal anti-inflammatory drug (NSAID), diclofenac sodium (at a dose of 10 mg/kg), and a vehicle control. All compounds were administered orally, 30 minutes prior to carrageenan injection. Paw volume

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measurements were taken at various time points after carrageenan injection (0, 1, 2, 3, 4, and 5 hours) using a plethysmometer to assess the extent of paw edema.

To evaluate the analgesic properties of the dexibuprofen the acetic acid-induced writhing model[10] was employed. Similar to the first experimental model, rats were randomly divided into three groups (n=6 per group) and received the dexibuprofen (at a dose of 10 mg/kg), diclofenac sodium (at a dose of 10 mg/kg), and a vehicle control respectively. The compounds were administered orally, 30 minutes before the injection of acetic acid. The number of writhes was counted over a 30-minute period starting 5 minutes after acetic acid injection to evaluate the analgesic effects of the treatments.

Ethical Considerations: Institutional animal ethics committee approval was taken from IAEC, at Mallareddy Medical College for Women, Suraram, Hyderabad, Telangana, India. before starting the experiment

Statistical Analysis: Data obtained from the experiments were subjected to statistical analysis using one-way analysis of variance[10] (ANOVA), followed by Tukey's post hoc test for multiple comparisons. A p-value less than 0.05 was considered statistically significant.

By utilizing these animal models of inflammation and pain, we aimed to determine the anti-inflammatory and analgesic efficacy of the dexibuprofen. The study design allowed for comparisons with a standard NSAID and a vehicle control, enabling the evaluation of the potential therapeutic effects of dexibuprofen in these animal models. The statistical analysis facilitated the identification of significant differences among the treatment groups, providing insights into the effectiveness of dexibuprofen as an anti-inflammatory and analgesic agent.

Results

Table 1: Anti-inflammatory activity of dexibuprofen and diclofenac sodium in the carrageenan-induced paw edema model in albino rats

The paw volume in the vehicle control group steadily increased over time, indicating the development of paw edema. However, treatment with both dexibuprofen and diclofenac sodium resulted in a significant reduction in paw volume compared to the control group at all time points.

Dexibuprofen exhibited a dose-dependent effect, with a greater reduction in paw volume observed in the dexibuprofen group compared to the diclofenac sodium group. Dexibuprofen showed a percentage inhibition of paw edema ranging from 53.2% to 74.7% across the different time points, while diclofenac sodium exhibited a percentage inhibition ranging from 49.8% to 68.9%.

These results indicate that both dexibuprofen and diclofenac sodium have anti-inflammatory properties in the carrageenan-induced paw edema model. Dexibuprofen demonstrated a comparable or even slightly superior efficacy compared to diclofenac sodium in reducing paw edema.

Table 2: Analgesic activity of dexibuprofen and diclofenac sodium in the acetic acid-induced writhing model in albino rats

The number of writhes, which represents the pain response, was significantly reduced in both the dexibuprofen and standard diclofenac groups compared to the vehicle control group.

Dexibuprofen exhibited a mean number of writhes of 6.3 ± 0.9, while the standard diclofenac group showed a mean number of writhes of 5.8 ± 0.8. These results indicate that both

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE 06, 2023

dexibuprofen and diclofenac sodium exerted analgesic effects in the acetic acid-induced writhing model.

In this model, there were no significant differences observed between the analgesic effects of dexibuprofen and diclofenac sodium. Both treatments demonstrated a notable reduction in the number of writhes, suggesting their potential as effective analgesic agents.

Overall, these findings suggest that dexibuprofen possesses significant anti-inflammatory and analgesic activities in albino rats, as demonstrated in the carrageenan-induced paw edema model and the acetic acid-induced writhing model. Dexibuprofen exhibited comparable or even superior efficacy compared to diclofenac sodium in reducing paw edema, while no significant differences were observed between the analgesic effects of dexibuprofen and diclofenac sodium.

Discussion

The findings of this study are consistent with previous research investigating the anti-inflammatory and analgesic activities of dexibuprofen in animal models. Several studies have reported the effectiveness of dexibuprofen in reducing paw edema and alleviating pain.

In comparison to previous studies, our results demonstrate that dexibuprofen exhibited significant anti-inflammatory effects in the carrageenan-induced paw edema model. The percentage inhibition of paw edema by dexibuprofen ranged from 53.2% to 74.7% across the different time points. These findings are in line with a study by Ricciotti E et al[11]., where dexibuprofen demonstrated comparable or even superior efficacy in reducing paw edema compared to other nonsteroidal anti-inflammatory drugs (NSAIDs) such as ibuprofen and diclofenac.

Moreover, the analgesic effects of dexibuprofen observed in the acetic acid-induced writhing model are consistent with previous studies. The significant reduction in the number of writhes in the dexibuprofen group indicates its ability to alleviate pain. These results align with the work of Wilkinson BL et al[12]. who reported that dexibuprofen exhibited potent analgesic effects in various pain models, including the writhing test.

Interestingly, in our study, no significant differences were observed between the analgesic effects of dexibuprofen and diclofenac sodium in the acetic acid-induced writhing model. This finding is consistent with a study conducted by Huang J et al[13] which also reported comparable analgesic efficacy between dexibuprofen and diclofenac sodium in a similar pain model.

It is important to note that the present study focused on the evaluation of dexibuprofen in albino rats. However, further investigations are needed to assess the translatability of these findings to humans. Clinical trials and studies in other animal models can provide additional evidence on the anti-inflammatory and analgesic properties of dexibuprofen and its potential as a therapeutic option for the management of inflammatory conditions and pain in humans.

Conclusion :

The results of this study, along with the comparison to previous findings, support the significant anti-inflammatory and analgesic activities of dexibuprofen. Dexibuprofen exhibited a dose-dependent reduction in paw edema and demonstrated analgesic effects in the animal models employed. These results contribute to the growing body of evidence highlighting the potential of dexibuprofen as a promising therapeutic agent. However, further

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE 06, 2023

research is warranted to elucidate the underlying mechanisms of action and to explore the clinical applications of dexibuprofen in human subjects.

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Table 1:Anti-inflammatory activity of dexibuprofen and diclofenac sodium in the carrageenan-induced paw edema model in albino rats

Time Point (hours)	Paw Volume in Vehicle Control (mL)	Paw Volume in dexibuprofen (mL)	Paw Volume in Diclofenac (mL)	Percentage Inhibition of Paw Edema by dexibuprofen (%)	Percentage Inhibition of Paw Edema by Standard diclofenac (%)
1	0.68 ± 0.02	0.32 ± 0.03	0.34 ± 0.03	53.2	49.8
2	0.80 ± 0.04	0.32 ± 0.03	0.36 ± 0.02	60.5	55.6
3	0.95 ± 0.05	0.30 ± 0.02	0.35 ± 0.03	68.8	63.5
4	1.08 ± 0.07	0.27 ± 0.02	0.33 ± 0.02	74.7	68.9

Table 2: Analgesic activity of dexibuprofen and diclofenac sodium in the acetic acid-induced writhing model in albino rats

Treatment Group	Number of Writhes (mean ± SEM)
Vehicle Control	14.2 ± 1.8
Dexibuprofen	6.3 ± 0.9
Standard Diclofenac	5.8 ± 0.8