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Inflammation and pain: a brief review of mechanisms and therapeutics

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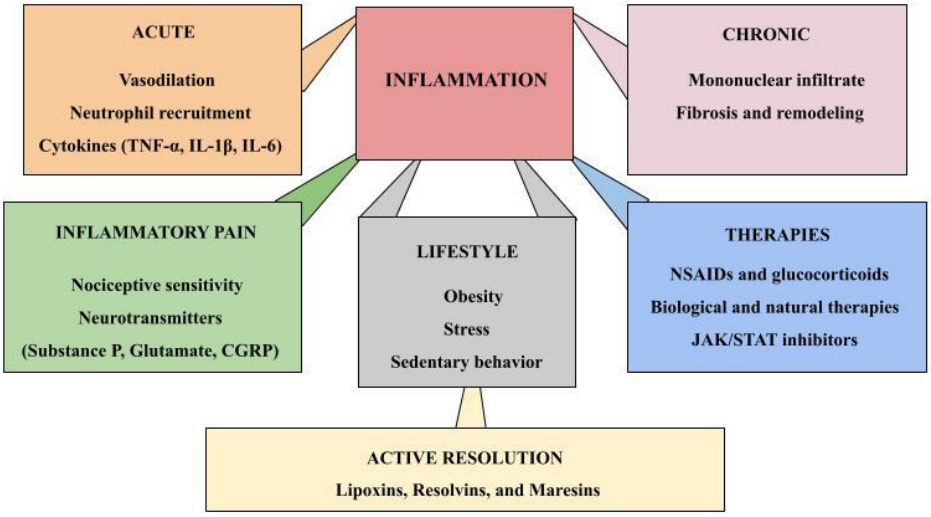
Highlights

- *Inflammation is an essential defense mechanism; however, its dysregulation may lead to chronic inflammation and tissue damage.*
- *Acute inflammation involves rapid vascular and immunological responses, whereas chronic inflammation is characterized by persistent injury, mononuclear cell infiltrate, and fibrosis.*
- *Pain arises from the action of inflammatory mediators on nociceptors, resulting in peripheral and central sensitization.*
- *Anti-inflammatory and analgesic drugs modulate mediators such as prostaglandins, histamine, serotonin, bradykinin, and cytokines, making their interaction crucial for the development of more effective therapies.*

Graphical Abstract



Abstract

Inflammation is a complex immunological response to harmful stimuli such as pathogens, damaged cells, and toxins, playing a fundamental role in host defense and tissue repair. This narrative review selected 41 recent studies addressing the cellular, molecular, and pathophysiological mechanisms of inflammation and its relationship with pain, including lifestyle influences and current and emerging therapeutic strategies. Acute inflammation is characterized by rapid onset, vasodilation, increased vascular permeability, and predominant neutrophil recruitment, with mediators such as prostaglandins, leukotrienes, histamine, bradykinin, and pro-inflammatory cytokines, and may generate systemic manifestations such as peripheral and pulmonary edema. Chronic inflammation results from failure of resolution, with persistent mononuclear infiltrate, tissue remodeling, fibrosis, and activation of the adaptive immune response. Inflammatory pain arises from peripheral sensitization of nociceptors and central activation, mediated by excitatory neurotransmitters, ion channels, and specific receptors, favoring hyperalgesia and chronification. Active resolution, promoted by lipoxins, resolvins, and maresins, modulates inflammation and nociception. Therapeutic interventions include nonsteroidal anti-inflammatory drugs, glucocorticoids, biological therapies, and JAK/STAT inhibitors; however, their adverse effects highlight the need for safer novel approaches. Lifestyle factors such as obesity, chronic stress, and physical inactivity contribute to low-grade inflammation and persistent pain. Understanding these interactions is crucial for the development of integrated strategies that reconcile anti-inflammatory and analgesic efficacy with clinical safety.

Keywords: Anti-inflammatory Drugs. Prostaglandins. Cytokines. Nociception. Analgesics.

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INTRODUCTION

The inflammatory process is an essential homeostatic phenomenon that enables the organism to respond efficiently to tissue injury and the presence of diverse antigens[1]. However, when dysregulated, this inflammatory response may exert deleterious effects on the organism, compromising its integrity and contributing to the development and progression of several diseases[2].

At the tissue level, inflammation is characterized by changes known as the cardinal signs and symptoms, which include redness, edema, heat, pain, and loss of tissue function, resulting from local responses of the immune system, the vascular system, and inflammatory cells[3]. According to the intensity and duration of the response, inflammation may be classified as acute or chronic[2].

Acute inflammation is a rapid tissue response to trauma, microbial infections, or exposure to harmful substances. It has a sudden onset, intense progression over a short period, and limited duration[4]. If it persists beyond this interval, the inflammatory process may evolve into a subacute phase, corresponding to an intermediate condition between acute and chronic inflammation[5].

In contrast, chronic inflammation is characterized by a prolonged course, which may last for months or years. The impact and severity of this process are directly related both to the nature of the injurious agent and to the organism's ability to repair damaged tissues and restore homeostasis[2].

Although many inflammatory mechanisms are well established, their complete understanding remains limited due to the complexity of the process and individual variability. Thus, the present study aimed to conduct a brief literature review to synthesize current knowledge on the mechanisms involved in inflammation, lifestyle influences, as well as available and emerging therapeutic approaches.

METHODS

This study is a narrative review based on articles indexed in databases such as Scopus, SciELO, Google Scholar, ScienceDirect, Web of Science, and PubMed, prioritizing, whenever possible, publications from the last ten years, regardless of QUALIS classification, Impact Factor, or language. The search employed combinations of descriptors using Boolean operators, including "inflammatory process" AND "pro-inflammatory mediators," "cardinal signs of inflammation" OR "symptoms of inflammation," "anti-inflammatory drugs" AND "analgesic properties," as well as the terms "lifestyle and inflammation" OR "lifestyle habits and inflammation" and "pharmacological therapies for inflammation" OR "non-pharmacological therapies for inflammation." Although this is a narrative review, the selected studies underwent critical reading to assess methodological clarity, consistency of results, and thematic relevance. Duplicate articles, those without full-text access, or those unrelated to the objectives of this study were excluded, whereas studies addressing inflammatory mechanisms, biochemical mediators, clinical manifestations, and strategies for pain modulation were included.

RESULTS

The search resulted in the selection of 41 articles that met the previously defined inclusion criteria. The results were presented through a synthesis of the evidence available in these studies, organized according to the main cellular, molecular, and pathophysiological components of the inflammatory response and its relationship with pain. Lifestyle influences on the inflammatory process were also considered, as well as currently available and emerging therapeutic approaches.

Acute vs. Chronic inflammation

Inflammation is described in the literature as an initial nonspecific response of the immune system[2], mobilized whenever the organism encounters potentially harmful stimuli such as pathogens, damaged cells, or toxins[6]. In addition to protecting against these insults, inflammation directly participates in tissue repair mechanisms. This process manifests through the cardinal signs classically described as tumor, rubor, calor, dolor, and loss of function[3], resulting from a coordinated set of cellular and vascular changes at the site of injury[3].

The distinction between acute and chronic inflammation, as described, is not based exclusively on temporal duration, but also on the nature of the recruited cells and the subsequent structural alterations[2]. This distinction allows for an understanding of the progression from immediate responses to persistent patterns of tissue remodeling, as summarized in Table 1.

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Table 1 - Comparison between acute inflammation and chronic inflammation.

Aspect	Acute inflammation	Chronic inflammation
General characteristics	Initial nonspecific response with rapid onset, associated with intense vascular changes, plasma extravasation, and immediate cellular recruitment, exerting protective and reparative roles.	Persistent response associated with failure of resolution mechanisms, sustained inflammatory stimuli, progressive tissue remodeling, and loss of protective function.
Duration	Short duration, usually lasting from hours to days.	Prolonged course, potentially persisting for weeks, months, or years.
Vascular changes	Local vasodilation, increased blood flow, elevation of capillary hydrostatic pressure, and increased vascular permeability, favoring edema formation.	Less exuberant but sustained vascular changes, associated with tissue remodeling and fibrosis.
Predominant cells	Initial predominance of neutrophils, with participation of platelets, basophils, and eosinophils depending on the stimulus.	Predominance of monocytes/macrophages and T and B lymphocytes, associated with the adaptive immune response.
Cellular dynamics	Rapid and organized leukocyte recruitment guided by chemokines, with possible neutrophilia and left shift.	Persistent cellular infiltrate, prolonged activation, and failure to eliminate the inflammatory stimulus.
Main mediators	Histamine, bradykinin, leukotrienes, prostaglandins (PGE_2, PGI_2, PGD_2), nitric oxide, TNF-α, IL-1β, and IL-6.	Sustained pro-inflammatory cytokines (TNF-α, IL-1β, IL-6), eicosanoids, and mediators associated with failure of resolution.
Relationship with pain	Peripheral sensitization of nociceptors, reduced neuronal firing threshold, inflammatory pain, and hyperalgesia.	Persistent peripheral and central sensitization, associated with chronic pain and greater difficulty of reversal.
Resolution mechanisms	Activation of pro-resolving pathways, such as lipoxins, resolvins, and maresins, promoting efferocytosis and restoration of homeostasis.	Insufficiency or failure of resolution pathways, favoring perpetuation of inflammation.
Outcomes	Complete resolution, tissue repair, and return to homeostasis when regulatory mechanisms are effective.	Tissue remodeling, fibrosis, organ dysfunction, and association with chronic inflammatory and painful diseases.

During the acute phase, progressive vasodilation, increased local blood flow, plasma extravasation, and recruitment of different leukocyte populations are observed[7,8]. Vasodilation is primarily modulated by mediators such as nitric oxide (NO) and prostaglandins of the I and D series, including prostacyclin (PGI_2), prostaglandin D_2 (PGD_2), and prostaglandin E_2 (PGE_2)[2], leading to increased capillary hydrostatic pressure[7]. Under extreme conditions, such as sepsis, similar mechanisms are associated with diffuse vasoplegia and a marked decrease in arterial blood pressure[9].

Increased vascular permeability occurs under the action of histamine, bradykinin, leukotrienes, complement fractions, substance P, and platelet-activating factor (PAF), favoring the extravasation of plasma proteins and fluids into the interstitium and the development of edema[10]. This phenomenon is particularly pronounced in postcapillary venules and pulmonary capillaries[11] and may culminate in systemic clinical manifestations such as peripheral and pulmonary edema[12].

Cells involved in the inflammatory response

Leukocyte recruitment, as described in the literature, is mediated by chemokines and their respective receptors[13] and occurs in a sequential manner. Neutrophils constitute the main cellular population recruited during the early phases, characterizing peripheral neutrophilia and a possible left shift[14].

Other cellular populations also exhibit characteristic changes: basophils tend to decrease in the circulation due to tissue migration[15]; eosinophils increase mainly in allergic or parasitic contexts[14], potentially contributing to bronchoconstriction and pulmonary edema; platelets participate early through the release of mediators and the integration between inflammation and coagulation[16].

With temporal progression of the response, monocytes migrate into tissues and differentiate into macrophages, which play a central role in phagocytosis, antigen presentation, and the release of inflammatory and regulatory mediators, in addition to contributing to tissue repair through the secretion of growth factors[17]. Under conditions of persistent stimulation, a transition to a chronic pattern occurs, with a progressive increase in T and B lymphocytes and activation of adaptive mechanisms associated with sustained cytokine release, tissue remodeling, and fibrosis[18].

Inflammatory mediators

Multiple chemical mediators act in an integrated manner in the inflammatory response, composing what the literature describes as an "inflammatory soup," characterized by the simultaneous presence of prostaglandins, leukotrienes, vasoactive amines, and cytokines, as illustrated in Figure 1.

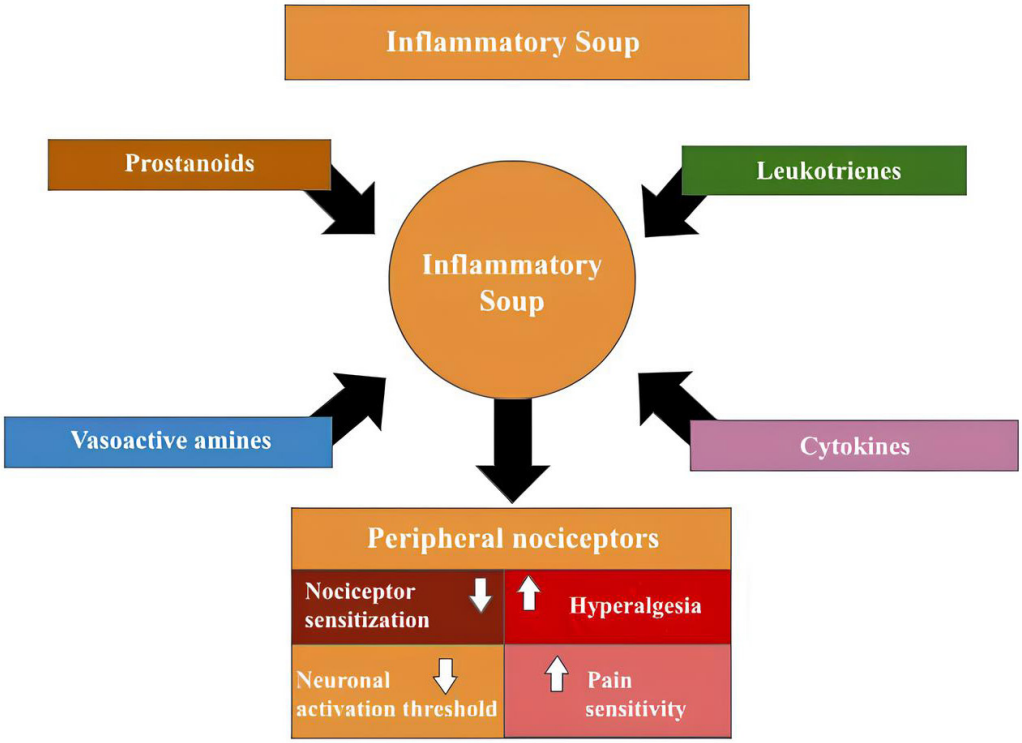

Figure 1 - Flowchart of the signaling mechanisms of inflammatory pain.

Prostaglandins of the E and I series are associated with vasodilation, fever, and pain intensification, whereas leukotrienes participate in leukocyte chemotaxis and bronchoconstriction[19]. In turn, histamine and bradykinin are notable for increasing vascular permeability and pain[10].

In addition, pro-inflammatory cytokines such as tumor necrosis factor alpha (TNF-α), interleukin-1 beta (IL-1β), and interleukin-6 (IL-6) play a central role in amplifying the inflammatory response by modulating the expression of adhesion molecules, cellular activation, and the liver-mediated acute-phase response[6]. Collectively, these mediators create an inflammatory microenvironment capable of promoting peripheral nociceptor sensitization, lowering the neuronal firing threshold, and contributing to the genesis and maintenance of inflammatory pain.

Mechanisms of pain and nociception

The literature describes a close relationship between inflammation and nociception, mediated by the sensitization of peripheral nociceptors by substances such as PGE_2, bradykinin, TNF-α, and IL-1β[19,20]. These mediators act on receptors and ion channels expressed at primary nerve endings, including the transient receptor potential vanilloid 1 (TRPV1), voltage-gated sodium channels, and G protein–coupled receptors, thereby reducing the neuronal firing threshold. As a consequence, excitability of Aδ and C fibers increases, favoring spontaneous pain and hyperalgesia throughout the progression of the inflammatory process[20].

Nociceptive signals generated in the periphery are transmitted to the central nervous system via primary afferent neurons, with synapses in the dorsal horn of the spinal cord[21]. At this level, excitatory neurotransmitters such as glutamate, substance P, and calcitonin gene-related peptide (CGRP) activate second-order neurons and glial cells, contributing to amplification of the pain signal. Persistent activation of these pathways may lead to central sensitization, characterized by enhanced neuronal responses to noxious and non-noxious stimuli, expansion of receptive fields, and maintenance of pain even in the absence of the initial peripheral stimulus[20,21], as detailed in Figure 2.

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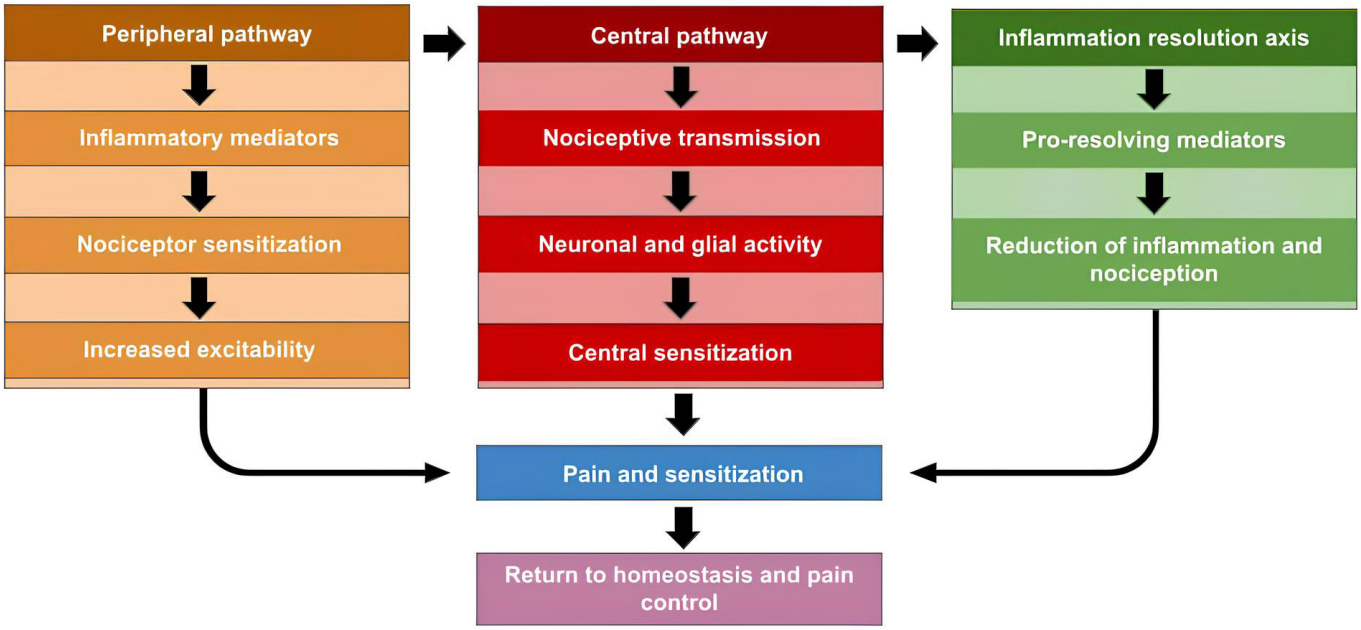

Figure 2 - Flowchart of inflammatory pain signaling mechanisms.

Additionally, the resolution of inflammation is described as an active process involving the production of specialized pro-resolving mediators, such as lipoxins, resolvins, and maresins, which are responsible for limiting cellular recruitment, stimulating efferocytosis, and restoring tissue homeostasis. These mediators also modulate nociception by reducing peripheral neuronal excitability and attenuating glial and synaptic activation in the central nervous system. Failure of these pathways is associated with persistence of the inflammatory process, maintenance of central sensitization, and the development of chronic conditions, including states of persistent inflammatory pain[20,22].

Current and future therapeutic approaches

Recent literature indicates that knowledge of the vascular, cellular, and molecular events involved in inflammation underpins the use of different therapeutic classes. Nonsteroidal anti-inflammatory drugs (NSAIDs) are described as agents that act primarily through inhibition of cyclooxygenase (COX) enzyme isoforms, resulting in reduced synthesis of pro-inflammatory prostaglandins[19]. In contrast, glucocorticoids, also referred to as steroidal anti-inflammatory drugs (SAIDs), are presented as broad modulators of the inflammatory response, exerting their effects through binding to nuclear receptors and regulation of gene expression of inflammatory mediators and enzymes of the arachidonic acid pathway, including COX isoforms[23].

In recent years, the literature has consistently documented the use of biological therapies in the treatment of chronic inflammatory diseases. These approaches mainly include monoclonal antibodies and fusion proteins directed against specific cytokines or their receptors, such as TNF-α, IL-6, IL-1β, and interleukin-17 (IL-17), and are described as capable of directly interfering with defined stages of inflammatory cascades and reducing pro-inflammatory signaling in different pathological contexts[24,25].

In addition, recent studies report the use of cytokine inhibitors and their receptors in diseases such as rheumatoid arthritis, inflammatory bowel diseases, and other immune-mediated conditions, with reductions in systemic inflammatory markers and clinical disease activity[26]. Therapeutic approaches based on small molecules are also described, such as inhibitors of the Janus kinase/signal transducer and activator of transcription (JAK/STAT) pathway, which act on intracellular modulation of inflammatory signaling and have become part of the most recent therapeutic arsenal for controlling chronic inflammation, especially in immune-mediated diseases refractory to conventional therapies[27].

DISCUSSION

The findings compiled in this review reinforce that inflammation constitutes an essential defense mechanism, but when dysregulated, it can generate significant deleterious consequences[6,28]. The consistent description of cardinal signs, vascular alterations, and cellular recruitment patterns confirms classical and contemporary models of the inflammatory response[2,3]. The distinction between acute and chronic inflammation emerges as a central element for understanding the transition between a protective response and a pathological state, frequently associated with fibrosis, persistent mononuclear infiltrate, and organ dysfunction[1,29].

The integrated analysis of cellular populations reveals a dynamic and temporally organized cascade in which neutrophils predominate in the early phases, followed by monocytes, macrophages, and lymphocytes in later phases[2,30]. This pattern reinforces the systemic role of inflammation, also reflected in peripheral hematological alterations such as anemia of chronic disease and quantitative platelet disorders, thereby expanding the clinical impact of the inflammatory response[16,31].

The inflammatory mediators described constitute a complex and interdependent network capable of explaining observed clinical signs and providing multiple therapeutic targets[7,32]. The differential activity of cyclooxygenase isoforms COX-1 and COX-2, as well as the central role of PGE_2 in pain and fever, supports the physiological basis for the use of NSAIDs and other pharmacological strategies[32,33].

The concept of the "inflammatory soup" describes the set of chemical mediators released into the tissue microenvironment following injury or inflammation, including prostaglandins, bradykinin, histamine, and pro-inflammatory cytokines, which act in an integrated manner to activate and sensitize nociceptors[34]. This interaction lowers the neuronal firing threshold and promotes the development of hyperalgesia and persistent inflammatory pain, illustrating how the inflammatory microenvironment intensifies the bidirectional relationship between inflammation and pain[35,36]. This model helps explain why anti-inflammatory and analgesic drugs often share mechanisms of action by modulating convergent mediators such as prostaglandins, bradykinin, serotonin, and cytokines[34,37].

Beyond classical mediators, recent literature highlights the endocannabinoid system as a relevant modulator of inflammation and pain[38]. Composed of endogenous ligands such as anandamide and 2-arachidonoylglycerol (2-AG), cannabinoid receptors type 1 (CB1) and type 2 (CB2), and enzymes of synthesis and degradation, this system acts as a physiological regulator of homeostasis[38]. Activation of CB2 in immune cells is associated with reduced release of pro-inflammatory cytokines and modulation of cellular migration, whereas CB1 signaling contributes to inhibition of nociceptive transmission by reducing neuronal excitability and the release of excitatory neurotransmitters[38,39].

The data discussed reinforce the relevance of innovative therapeutic strategies aimed at more selective control of inflammation and pain[6,25]. Considering the limitations of current treatments, investigation of new natural, synthetic, or semisynthetic compounds remains essential for the management of chronic inflammatory and painful conditions, with potential positive impacts on systemic physiology and quality of life[24,25].

Advances in understanding the vascular, cellular, and molecular mechanisms of inflammation have played a central role in the development of new therapeutic strategies, particularly through identification of specific targets within inflammatory cascades. Recognition of the role of pro-inflammatory cytokines, intracellular signaling pathways, and lipid mediators has enabled a transition from nonspecific therapies to more targeted approaches, such as biological agents and inhibitors of critical molecular pathways, exemplifying a clear translational application of basic knowledge to clinical practice[6,25].

These advances are particularly evident in chronic inflammatory diseases such as rheumatoid arthritis and other immune-mediated conditions, in which understanding the roles of TNF-α, IL-6, and IL-17 has supported the development of therapies capable of reducing systemic inflammation, tissue damage, and associated pain[24,25]. Similarly, in conditions such as osteoarthritis and painful neuropathies, identification of the interaction between persistent inflammation, peripheral and central nociceptive sensitization, and tissue remodeling helps explain pain chronification and guides the rational use of pharmacological and non-pharmacological approaches[34,40].

Beyond molecular mechanisms, lifestyle-related factors and comorbidities exert significant influence on chronic inflammation and pain. Conditions such as obesity, chronic stress, and physical inactivity are associated with a low-grade inflammatory state characterized by sustained release of pro-inflammatory cytokines and increased oxidative stress, favoring both persistence of inflammation and nociceptive sensitization[4,41]. Therefore, effective control of inflammation and pain requires an integrated approach that considers not only pharmacological interventions targeting biological mechanisms but also strategies aimed at modulating behavioral and metabolic factors that contribute to maintenance of the inflammatory process.

CONCLUSION

The inflammatory process is essential for host defense, but its dysregulation contributes to chronic pain and multiple pathologies. The interaction between inflammation and nociception reveals the complexity of the mechanisms involved and highlights significant gaps in our understanding of the cellular and molecular pathways that simultaneously modulate inflammatory responses and pain.

It remains unclear how different mediators interact across acute and chronic phases or which targets may provide effective analgesia without compromising essential physiological functions. These limitations reinforce the need for research exploring more integrated and dynamic experimental models capable of evaluating complete cellular circuits. Investigation of new molecular targets, including selective modulators of prostaglandins, inflammation-sensitive ion channels, and specific mediators, may lead to more precise and safer therapies.

Finally, the importance of translating basic knowledge into clinical practice is emphasized in order to develop interventions that maintain anti-inflammatory and analgesic efficacy while minimizing adverse effects. Progress in this field depends on the integration of fundamental research, robust models, and therapeutic innovation.

CRediT author statement

Conceptualization: Franco, RM; Franco, RR. Methodology: Franco, RR. Formal analysis: Franco, RM; Pinto, FRM; Diaz, EHV; Franco, RR. Investigation: Franco, RM; Pinto, FRM; Diaz, EHV; Franco, RR. Supervision: Franco, RR. Project administration: Franco, RR. Writing – original draft: Franco, RM. Writing – review and editing: Franco, RR.

All authors have read and agreed to the published version of the manuscript.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the workreported in this paper.

REFERENCES

1. Chen Y, et al. The NLRP3 inflammasome: contributions to inflammation-related diseases. Cell Mol Biol Lett. 2023;28(1):51. https://doi.org/10.1186/s11658-023-00462-9
2. Jameel N, et al. Inflammation demystified: an in-depth comprehensive review. Biomed Res Ther. 2025;12(10):7820-7836. https://doi.org/10.15419/17639y26
3. Chen R, et al. Pattern recognition receptors: function, regulation and therapeutic potential. Signal Transduct Target Ther. 2025;10(1):216. https://doi.org/10.1038/s41392-025-02264-1
4. Chen L, Deng H, Cui H, Fang J, et al. Inflammatory responses and inflammation-associated diseases in organs. Oncotarget. 2018;9(6):7204. https://doi.org/10.18632/oncotarget.23208
5. Zhou Y, Hong Y, Huang H. Triptolide attenuates inflammatory response in membranous glomerulonephritis rat via downregulation of NF-κB signaling pathway. Kidney Blood Press Res. 2016;41(6):901-910. https://doi.org/10.1159/000452591
6. Medzhitov R. The spectrum of inflammatory responses. Science. 2021;374(6571):1070-1075. https://doi.org/10.1126/science.abi5200
7. Abdulkhaleq L, Assi M, Abdullah R, Zamri-Saad M, et al. The crucial roles of inflammatory mediators in inflammation: a review. Vet World. 2018;11(5):627-635. https://doi.org/10.14202/vetworld.2018.627-635
8. Mortimer PM, McIntyre SA, Thomas DC. Beyond the extra respiration of phagocytosis: NADPH oxidase 2 in adaptive immunity and inflammation. Front Immunol. 2021;12:733918. https://doi.org/10.3389/fimmu.2021.733918
9. Vieira NF, Barbosa TP, Cárnio EC. Performance of nitric oxide in sepsis: a scoping review. Acta Paul Enferm. 2024;37:eAPE00512. https://doi.org/10.37689/acta-ape/2024AR00005122
10. Chi Y, Liu X, Chai J. A narrative review of changes in microvascular permeability after burn. Ann Transl Med. 2021;9(8):719. https://doi.org/10.21037/atm-21-1267
11. Cheetham CJ, et al. Neutrophil-derived proteases in lung inflammation: old players and new prospects. Int J Mol Sci. 2024;25(10):5492. https://doi.org/10.3390/ijms25105492
12. Soeters PB, Wolfe RR, Shenkin A. Hypoalbuminemia: pathogenesis and clinical significance. J Parenter Enteral Nutr. 2019;43(2):181-193. https://doi.org/10.1002/jpen.1451
13. Wang J, et al. Progress in structure-based drug development targeting chemokine receptors. Front Pharmacol. 2025;16:1603950. https://doi.org/10.3389/fphar.2025.1603950
14. Germolec DR, Shipkowski KA, Frawley RP, Evans E. Markers of inflammation. In: Immunotoxicity Testing. Cham: Springer; 2018. p. 57-79. https://doi.org/10.1007/978-1-4939-8549-4_5
15. Yanase Y, et al. Basophil characteristics as a marker of the pathogenesis of chronic spontaneous urticaria. Int J Mol Sci. 2023;24(12):10320. https://doi.org/10.3390/ijms241210320
16. Yan M, et al. Platelet signaling in immune landscape: comprehensive mechanism and clinical therapy. Biomark Res. 2024;12(1):164. https://doi.org/10.1186/s40364-024-00700-y
17. Jin C, et al. Cellular and molecular mechanisms of wound repair: from biology to therapeutic innovation. Cells. 2025;14(23):1850. https://doi.org/10.3390/cells14231850
18. Sonnenberg GF, Artis D. Innate lymphoid cells in the initiation, regulation and resolution of inflammation. Nat Med. 2015;21(7):698-708. https://doi.org/10.1038/nm.3892

19. Macia Guardado M, et al. The role of prostaglandins as major inflammatory mediators in colorectal cancer. Int J Mol Sci. 2025;26(24):12191. https://doi.org/10.3390/ijms262412191
20. Cascella M, et al. Pathophysiology of nociception and rare genetic disorders with increased pain threshold or pain insensitivity. Pathophysiology. 2022;29(3):435-452. https://doi.org/10.3390/pathophysiology29030035
21. Liu S, Kelliher L. Physiology of pain: a narrative review on the pain pathway and its application in pain management. Dig Med Res. 2022;5:100. https://doi.org/10.21037/dmr-21-100
22. Serhan CN. Treating inflammation and infection in the 21st century: new hints from decoding resolution mediators and mechanisms. FASEB J. 2017;31(4):1273-1288. https://doi.org/10.1096/fj.201601222R
23. Cummins CL, Goldstein I. New anti-inflammatory mechanism of glucocorticoids uncovered. Trends Endocrinol Metab. 2025. https://doi.org/10.1016/j.tem.2024.08.003
24. Smolen JS, Landewé RBM, Bijlsma JWJ, Burmester GR, Dougados M, Kerschbaumer A, et al. EULAR recommendations for the management of rheumatoid arthritis: 2019 update. Ann Rheum Dis. 2020;79(6):685-699. https://doi.org/10.1136/ard-2024-226019
25. Schett G, McInnes IB, Neurath MF. Reframing immune-mediated inflammatory diseases through signature cytokine hubs. Nat Rev Rheumatol. 2021;17(12):719-734. https://doi.org/10.1056/NEJMra1909094
26. Taylor PC, Keystone EC, van der Heijde D, Weinblatt ME, Del Carmen Morales L, Reyes Gonzaga J, et al. Baricitinib versus placebo or adalimumab in rheumatoid arthritis. Ann Rheum Dis. 2020;79(7):988-997. https://doi.org/10.1136/annrheumdis-2017-212461
27. Nash P, et al. Expert consensus statement on the treatment of immune-mediated inflammatory diseases with Janus kinase inhibitors: 2024 update. Ann Rheum Dis. 2025;84(5):664-679. https://doi.org/10.1016/j.ard.2025.01.032
28. Gushiken LFS, et al. Cutaneous wound healing: an update from physiopathology to current therapies. Life (Basel). 2021;11(7):665. https://doi.org/10.3390/life11070665
29. Zhao R, Liang H, Clarke E, Jackson C, et al. Inflammation in chronic wounds. Int J Mol Sci. 2016;17(12):2085. https://doi.org/10.3390/ijms17122085
30. Garlanda C, Di Ceglie I, Jaillon S. IL-1 family cytokines in inflammation and immunity. Cell Mol Immunol. 2025;22:1-18. https://doi.org/10.1038/s41423-025-01358-8
31. Neal SV, Rudmann DG, Corps KN. Artificial intelligence in veterinary clinical pathology: an introduction and review. Vet Clin Pathol. 2025. https://doi.org/10.1111/vcp.70012
32. Peh HY, Chen J. Pro-resolving lipid mediators and therapeutic innovations in resolution of inflammation. Pharmacol Ther. 2025;265:108753. https://doi.org/10.1016/j.pharmthera.2024.108753
33. Park WH. Eicosanoids and inflammation: a delicate balance of pro-inflammatory and pro-resolving mediators. Biochem Pharmacol. 2025:117662. https://doi.org/10.1016/j.bcp.2025.117662
34. Basbaum AI, Bautista DM, Scherrer G, Julius D. Cellular and molecular mechanisms of pain. Cell. 2009;139(2):267-284. https://doi.org/10.1016/j.cell.2009.09.028
35. Karcz M, et al. Pathophysiology of pain and mechanisms of neuromodulation: a narrative review. J Pain Res. 2024;17:3757-3790. https://doi.org/10.2147/JPR.S475351
36. Curatolo M. Central sensitization and pain: pathophysiologic and clinical insights. Curr Neuropharmacol. 2024;22(1):15-22. https://doi.org/10.2174/1570159X20666221012112725
37. Chen Y, et al. The mechanisms of specialize d pro-resolving mediators in pain relief. Front Immunol. 2025;16:1634724. https://doi.org/10.3389/fimmu.2025.1634724
38. Johnson BW, Strand NH, Raynak JC, Jara C, et al. Cannabinoids in chronic pain management. Biomedicines. 2025;13(3):530. https://doi.org/10.3390/biomedicines13030530
39. Paolini L, Sigaux J, Boissier MC, Rivière E. Immune control of pain. Joint Bone Spine. 2025:105999. https://doi.org/10.1016/j.jbspin.2025.105999
40. Santiago BVM, et al. Prevalence of chronic pain in Brazil: a systematic review and meta-analysis. Clinics (Sao Paulo). 2023;78:100209. https://doi.org/10.1016/j.clinsp.2023.100209
41. Tumilaar SG, et al. A comprehensive review of free radicals, oxidative stress, and antioxidants. J Chem. 2024;2024:5594386. https://doi.org/10.1155/2024/5594386

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