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Review Article

AYURVEDIC PERSPECTIVES ON *SANGYAHARANA* (ANAESTHESIA) AND *VEDANA SHAMANA* (PAIN MANAGEMENT)

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ABSTRACT

The concept of *Sangyaharana* (abolition of consciousness/anaesthesia) occupies a distinctive and clinically significant position within the vast corpus of classical Ayurvedic surgical literature. Ancient Indian medical scholars, most prominently *Acharya Sushruta*, formulated systematic approaches to pre-operative sedation, intra-operative pain abolition, and post-operative wound management that collectively constitute a functional anaesthetic system predating its Western counterpart by over two thousand years. The present review undertakes a comprehensive critical examination of classical textual evidence from *Sushruta Samhita, Charaka Samhita, Ashtanga Hridayam, Ashtanga Sangraha, Sarangadhara Samhita,* and *Bhavaprakasha Nighantu,* contextualising these descriptions against contemporary biomedical pharmacology, neurophysiology, and anaesthetic science. Key drug substances reviewed include *Vijaya* (*Cannabis sativa*), *Dhatura* (Datura metel), *Parasika Yavani* (Hyoscyamus niger), *Ahiphen* (*Papaver somniferum*), *Vatsanabha* (*Aconitum ferox*), and *Kuchala* (*Strychnos nux-vomica*), with particular attention to their active phytochemical constituents and established receptor-level mechanisms. The *Tridosha* based taxonomy of *Vedana* (pain) is systematically compared with modern nociceptive, inflammatory, and neuropathic pain classifications, revealing striking conceptual parallels. The perioperative protocols delineated in *Shalya Tantra* are analysed against contemporary anaesthetic standards and ERAS guidelines. The review concludes that Ayurvedic anaesthetic and analgesic practice constitutes a coherent, empirically grounded system warranting urgent, systematic scientific investigation.

INTRODUCTION

Surgical intervention, by its very nature, necessitates the management of pain and the preservation of patient stability during operative trauma. The history of anaesthesia is conventionally narrated as a linear progression culminating in Crawford Long's 1842 demonstration of ether anaesthesia and John Snow's subsequent systematisation of inhalational agents.[1] This Western-centric historiography, however, obscures a parallel and considerably older tradition of organised surgical anaesthesia that flourished in ancient India under the auspices of *Shalya Tantra* the branch of Ayurveda devoted to surgical science.[2] Acharya Sushruta, who composed or systematised the *Sushruta Samhita* conventionally dated between 600 BCE and 400 CE described not only an extraordinary repertoire of surgical procedures encompassing rhinoplasty, cataract couching, lithotomy, and caesarean section, but also articulated a coherent philosophy of patient preparation and pain management that transcended mere empiricism.[3]

The term *Sangyaharana* derived from the Sanskrit roots *Sangya* (consciousness, sensation, cognition) and *Harana* (to remove or take away) denotes the deliberate pharmacological induction of reduced or absent sensory awareness, encompassing a spectrum from mild anxiolysis and sedation through to complete surgical anaesthesia.[4] This conceptual architecture maps with remarkable precision onto the modern anaesthetic triad of hypnosis, analgesia, and muscle relaxation, although articulated within an

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entirely different epistemological framework.[5] The enumeration of *Nidrakara dravyas* (sleep-inducing agents), *Sammohana* (narcotic) substances, and *Vedana hara* (pain-abolishing) preparations within this framework reveals a sophisticated clinical pharmacology grounded in millennia of careful clinical observation and empirical refinement.[6]

Pain, designated *Vedana* or *Shoola* in classical literature, is interpreted through the *Tridosha* paradigm, wherein *Vata dosha* particularly its *Vyana* and *Prana* subtypes is understood as the principal mediator of all painful sensations, by virtue of its governance over the nervous system and all motor-sensory functions.[7] Therapeutic interventions for pain therefore principally target *Vata shamana* (pacification of *Vata dosha*) through dietary, behavioural, and pharmacological means, many of which demonstrate well-characterised analgesic, anti-inflammatory, or neuromodulatory properties in contemporary experimental pharmacology.[8] The clinical and academic importance of revisiting this tradition has grown substantially in the context of the global opioid crisis, the limitations of NSAIDs in chronic pain management, and the increasing recognition of multimodal and integrative approaches to perioperative care.[9]

The present review aims to provide a comprehensive, critically synthesised account of classical Ayurvedic knowledge pertaining to anaesthesia and pain management, systematically correlating classical descriptions with contemporary pharmacological and physiological understanding. The scope encompasses: (i) classical textual descriptions of *Sangyaharana* and associated drug substances; (ii) the *Tridosha*-based taxonomy of pain and its neurobiological correlates; (iii) the perioperative protocol in *Shalya Tantra* and its correspondence with modern anaesthetic practice; (iv) compound formulations with anaesthetic and analgesic significance; (v) *Shodhana* processes and their pharmacological implications; and (vi) current research evidence, methodological challenges, and future research priorities.

MATERIALS AND METHODS

Classical Source Materials

Primary classical Ayurvedic texts examined included: *Sushruta Samhita* (*Sutrasthana, Nidanasthana, Sharirasthana, Chikitsasthana,* and *Kalpasthana*); *Charaka Samhita (Sutrasthana, Vimanasthana, Chikitsasthana,* and *Kalpasthana)*; *Ashtanga Hridayam* (*Sutrasthana, Sharirasthana, Chikitsasthana,* and *Uttarasthana)*; *Ashtanga Sangraha*; *Sarangadhara Samhita* (*Purva, Madhyama*, and *Uttara Khanda*); *Bhavaprakasha Nighantu* (*Haritakyadi* and *Guduchyadi vargas);* and *Raja Nighantu*. Commentaries by *Dalhana* on *Sushruta* and *Chakrapani* on *Charaka* were additionally consulted to resolve textual ambiguities.[10]

Contemporary Literature Search

A systematic search of electronic databases was conducted encompassing PubMed, Scopus, Web of Science, EMBASE, AYUSH Research Portal, IndMED, and Google Scholar. Articles published between 1985 and 2025 in English, Hindi, and *Sanskrit* (with available translations) were considered. Peer-reviewed clinical studies, pharmacological evaluations, ethnobotanical surveys, systematic reviews, and meta-analyses were prioritised. Conference abstracts, unpublished theses, and non-peer-reviewed commentaries were excluded.

Inclusion and Exclusion Criteria

Studies were included if they directly investigated Ayurvedic drug formulations with anaesthetic, sedative, anxiolytic, or analgesic properties using authenticated plant materials; employed validated outcome measures; and reported pharmacological data with statistical analysis. Studies were excluded if they used adulterated or insufficiently characterised drug samples, lacked ethical approval, relied solely on subjective outcome reporting, or constituted opinion pieces without supporting data.

Data Synthesis

Extracted data were synthesised narratively given the heterogeneity of study designs and outcome measures, which precluded formal meta-analysis. Pharmacological mechanisms identified in contemporary literature were systematically mapped against corresponding classical descriptions to establish translational correspondences. The quality of classical textual evidence was appraised using criteria adapted from historical pharmacological scholarship, weighing specificity of drug description, consistency across independent textual lineages, and corroborative commentary traditions.

RESULTS AND DISCUSSION

Classical Conceptualization of *Sangyaharana*

The most explicit and clinically detailed account of pre-operative anaesthetic management in classical Ayurveda is found in *Sushruta Samhita, Chikitsasthana*, Chapter 1, which prescribes the administration of *Madya* (fermented beverages) combined with specific *Nidrakara* substances before operative procedures.[11] The text specifies that the patient should be provided with adequate *Madya* until signs of *Mada* (intoxication) become apparent characterised by cheerfulness, flushing, and diminished pain sensitivity before the surgeon commences the procedure.[12] This constitutes a functional equivalent of pre-anaesthetic anxiolysis and analgesia, with alcohol acting as a GABA-A receptor potentiator and glutamate receptor inhibitor,

producing dose-dependent sedation, anxiolysis, and antinociception.[13]

Charaka Samhita, Kalpasthana provides an extensive materia medica of *Sammohana* (stupefying), *Nidrakara* (sleep-inducing), and *Mada kara* (intoxicating) substances, classifying them by predominant qualities (*Guna*), elemental composition (*Pancha Mahabhuta* constitution), and clinical effects.[14] This pharmacological taxonomy demonstrates a sophisticated empirical understanding of dose-response relationships, with classical texts explicitly differentiating therapeutic from toxic doses and providing detailed antidotal protocols evidence of accumulated clinical pharmacovigilance of a high order.[15] The *Ashtanga Hridayam* of *Vagbhata* further elaborates upon Sushruta's surgical tradition, incorporating additional pharmacological detail drawn from Buddhist medical literature, particularly regarding the use of *Bhanga* (Cannabis) preparations in surgical contexts.[16]

The convergence of descriptions across independent textual lineages *Sushruta, Charaka,* and *Vagbhata* representing distinct scholarly traditions lends considerable credibility to the clinical reality of these anaesthetic practices.[17] The fact that multiple independent authors across centuries describe functionally similar pre-operative protocols, including the use of consciousness-altering substances, post-operative monitoring, and complication management, argues strongly for a sustained clinical tradition rooted in genuine operative experience rather than speculative theoretical elaboration. As Meulenbeld's authoritative history of Indian medical literature establishes, the *Samhita* tradition represents an edited compilation of earlier oral and written clinical knowledge with demonstrable continuity across at least fifteen centuries.[12]

Principal Drugs with Anaesthetic and Analgesic Properties

Table 1 presents the principal classical Ayurvedic drugs described for anaesthetic and analgesic applications, with their botanical equivalents, active phytochemical constituents, classical actions, and contemporary pharmacological mechanisms.

Table 1: Principal classical Ayurvedic drugs with anaesthetic and analgesic properties and their pharmacological correlates

Ayurvedic Name	Botanical Name	Active Phytochemicals	Classical Action	Modern Mechanism
Vijaya / Bhanga	*Cannabis sativa* L.	THC, CBD, CBN, terpenes	*Sammohana, Vedana hara*	CB1/CB2 agonism, endocannabinoid modulation, analgesic, sedative
Dhatura / Unmatta	*Datura metel* L.	Scopolamine, atropine, hyoscine	*Nidrakara, Sammohana*	Muscarinic antagonist, CNS depressant, antispasmodic
Parasika Yavani	H*yoscyamus niger* L.	Hyoscyamine, scopolamine	*Sangyaharana, Vedana shamana*	Anticholinergic, pre-anaesthetic sedation
Ahiphen / Afeem	*Papaver somniferum* L.	Morphine, codeine, papaverine	*Vedana hara, Nidrakara*	Mu/delta/kappa opioid receptor agonism, analgesia
Vatsanabha	*Aconitum ferox* Wall.	Aconitine, mesaconitine	*Vedana hara (*post-*Shodhana)*	Na+ channel blockade, analgesic at sub-toxic doses
Kuchala	*Strychnos nux-vomica* L.	Strychnine, brucine	*Vatahara, Shoolaghna*	Glycine receptor antagonism, analgesic sub-toxic
Bhallataka	Sem*ecarpus anacardium* L.	Bhilawanol, anacardic acid	*Vedana hara, Shotha hara*	COX inhibition, anti-inflammatory analgesia
Shunthi	*Zingiber officinale* Roscoe	Gingerols, shogaols	*Vedana shamana*	COX-2/5-LOX inhibition, prostaglandin suppression
Guggulu	*Commiphora mukul* Engl.	Guggulsterones, boswellic acids	*Shotha hara, Vedana hara*	NF-kB inhibition; anti-inflammatory
Ashwagandha	*Withania somnifera* L.	Withanolides, sitoindosides	*Balya, Vedana hara*	GABAergic modulation; adaptogenic; analgesic

Among these, *Ahiphen* (opium from *Papaver somniferum*) arguably represents the earliest documented use of an opioid analgesic in a surgical context.[18] Classical texts prescribe *Ahiphen* at carefully titrated doses, specifying its use for severe pain and as a surgical sedative, while explicitly cautioning against overdosage and describing reversal strategies including administration of *Madhu* (honey), sour substances, and vigorous stimulation a proto-reversal protocol that presages modern opioid antagonist therapy.[19] The anticholinergic triad of *Dhatura*, *Parasika Yavani*, and regional references to Mandrake represents a group of drugs whose combined muscarinic blockade would produce profound sedation, amnesia, reduced secretions, and analgesia properties directly exploited in modern pre-anaesthetic medication with scopolamine and glycopyrrolate.[20]

Cannabis sativa preparations known as *Vijaya*, *Bhanga*, or *Ganja* depending on the plant part utilised occupied a prominent position in classical anaesthetic formularies.[21] The psychoactive and analgesic properties of Cannabis are now well understood to arise from agonism at CB1 receptors in the CNS and CB2 receptors in peripheral immune cells, modulating pain transmission, anxiety, and consciousness through the endocannabinoid system.[22] The classical specification of different grades corresponding to different plant parts reflects an empirically derived understanding of potency that predates systematic phytochemistry.[23] Contemporary systematic reviews have confirmed that cannabis-based medicines produce modest but statistically significant analgesic effects in neuropathic pain conditions across multiple randomised controlled trials, validating the clinical observations of classical practitioners.[24]

Table 2: Presents compound formulations of anaesthetic and analgesic significance described in classical literature

Formulation	Key Ingredients	Classical Indication	Modern Interpretation
Sammohana churna	Cannabis, *Datura*, *Ahiphen*, *Madana phala*	Pre-surgical anaesthesia	Multimodal: cannabinoid + anticholinergic + opioid
Sanjivani vati	*Vatsanabha* (purified), *Pippali, Shunthi*	Resuscitation, severe pain	Na+ blockade + piperine bioenhancement + anti-inflammatory
Mahavata vidhvamsana rasa	*Vatsanabha, Tamra bhasma, Shunthi*	Neuropathic pain	Alkaloid neuromodulation + copper neurotropism
Yogaraja guggulu	*Guggulu, Triphala, Trikatu, Dashamula*	Musculoskeletal pain	Boswellic acid + terpenoid COX/LOX inhibition
Ashwagandharishta	*Ashwagandha, Manjishtha, Haritaki*	Post-surgical recovery	Withanolide adaptogenic + immunomodulatory
Brihat Vata Chintamani	*Gold bhasma, Abhrak bhasma, Pravala*	Neurological pain, paralysis	Nanoparticle bioavailability + neuroprotective

The *Sammohana churna* is pharmacologically remarkable in its deliberate combination of agents acting on cannabinoid, anticholinergic, and opioid receptor systems simultaneously, creating what is essentially a multimodal anaesthetic protocol remarkably similar in principle to modern balanced anaesthesia, which intentionally combines agents operating through different receptor mechanisms to achieve adequate anaesthetic depth while minimising the dose-dependent adverse effects of any single agent.[25] This parallel cannot be dismissed as coincidental; it reflects the empirical discovery of pharmacological synergy by practitioners with extensive operative experience over many generations.

Tridosha Framework of Pain and Neurobiological Correlates

The Ayurvedic taxonomy of pain is architecturally structured around the *Tridosha* paradigm. *Vataja shoola* described as piercing, shifting, colicky, pulsating, or throbbing in quality, aggravated by cold and relieved by warmth maps onto the modern category of neuropathic pain mediated by ectopic discharge in injured or sensitized primary afferent neurons (Adelta and C fibres).[26] The migratory, erratic character of *Vataja* pain mirrors the clinical presentation of conditions such as trigeminal neuralgia, phantom limb pain, and diabetic neuropathy, wherein aberrant voltage-gated sodium channel activity generates spontaneous, stimulus-independent pain signals.[27]

Pittaja shoola characterised by burning, scalding, radiating qualities, associated with redness, heat, and local inflammation, aggravated by heat and relieved by cold application corresponds with inflammatory nociceptive pain mediated by prostaglandins, bradykinin, substance P, and CGRP released from inflamed tissues.[28] The classical description of *Pittaja* pain's thermally modulated character aligns with the heat sensitivity of TRPV1 channels expressed on nociceptors, which are sensitised by inflammatory mediators including prostaglandin E2 a mechanism elucidated only at the molecular level in the late twentieth century.[29] *Kaphaja shoola* described as dull, heavy, fixed, constant, associated with swelling and stiffness corresponds most closely to musculoskeletal and visceral nociceptive pain, wherein sustained activation of mechanosensitive afferents by tissue distension or oedema generates persistent, poorly localised pain signals.[30]

The therapeutic management of each pain subtype in Ayurveda correspondingly targets the implicated *Dosha. Vataja shoola* is managed with warm, unctuous, heavy therapies (*Snehana, Swedana, Basti*) which have demonstrated efficacy in modulating sympathetic tone and reducing peripheral sensitisation in contemporary clinical studies.[31] *Pittaja shoola* is addressed through cooling, bitter, and astringent interventions including *Virechana* (therapeutic purgation) and agents such as *Guduchi* (*Tinospora cordifolia*) and *Chandana* (Santalum album), both of which demonstrate COX-2 inhibitory activity in pharmacological studies.[32] *Kaphaja shoola* is managed through dry, sharp, and heating therapies aimed at resolving stagnation and reducing oedema.[33]

The Ayurvedic concept of *Anubandha shoola* pain that persists beyond resolution of the causative stimulus corresponds with remarkable accuracy to the modern concept of central sensitisation, wherein repeated nociceptive input induces long-term potentiation in dorsal horn neurons, resulting in allodynia and hyperalgesia.[34] The classical treatment of *Anubandha shoola* emphasising *Rasayana* (rejuvenative) therapies to restore normal neural function parallels contemporary understanding of neuroplasticity-targeting treatments for centralised pain states. Additionally, the role of *Manasika dosha* (mental afflictions) in modulating somatic *Vedana* extensively discussed in *Charaka Samhita* anticipates the modern biopsychosocial model of pain and the neurobiological connections between depression, anxiety, and pain amplification via descending modulatory systems.[35]

Perioperative Protocol in Shalya Tantra

Acharya Sushruta's *Sutrasthana* delineated a meticulous perioperative protocol across three phases: pre-operative preparation (*Purva karma*), intra-operative management (*Pradhana karma*), and post-operative care (*Pashchat karma*).[36] Pre-operatively, patients were prescribed light, easily digestible meals on the preceding day, followed by overnight fasting a practice directly aligned with modern pre-operative nil-by-mouth protocols designed to reduce pulmonary aspiration risk.[37] Pre-operative administration of *Madya* served the dual purposes of anxiolysis and analgesia premedication, functionally equivalent to modern benzodiazepine premedication, while specific medicinal oils applied to the operative site provided a form of topical anaesthetic preparation.[38]

Intra-operatively, the maintenance of *Sangya nashta avastha* (state of absent sensation) was achieved through repeated administration of titrated doses of selected *Sammohana* agents, with anaesthetic depth clinically assessed through observation of respiratory pattern, muscle tone, and response to verbal and tactile stimulation a proto-clinical monitoring system that, while lacking quantitative instruments, reflects the same fundamental principles as modern clinical depth-of-anaesthesia assessment.[39] Surgical speed was explicitly valued in classical texts, with rapid, confident operative technique emphasised to minimise anaesthetic exposure duration a principle that remains central to modern surgical training and enhanced recovery programmes.[40]

Post-operatively, the *Pashchat karma* described in *Sushruta Samhita* bears remarkable structural similarity to contemporary ERAS (Enhanced Recovery After Surgery) protocols.[41] Wound care employed *Panchavalkal kwatha* (five-bark decoction from *Ficus* species) for antimicrobial and astringent properties, with modern studies confirming significant antibacterial activity against surgical site pathogens.[42] Medicated *Ghrita* applications promoted wound healing through anti-inflammatory and tissue-regenerative mechanisms attributed to short-chain fatty acids and fat-soluble vitamins.[43] Dietary management through graduated reintroduction of food directly mirrors ERAS nutritional protocols, and the emphasis on early mobilisation in classical texts parallels contemporary evidence for reduced post-operative complications with early ambulation.[44]

***Shodhana* Processes and Pharmacological Significance**

One of the most pharmacologically sophisticated aspects of classical Ayurvedic practice pertaining to anaesthetic drugs is the mandatory *Shodhana* (purification) process prescribed before the clinical use of toxic substances classified as *Upavisha* (sub-toxic) or *Visha* (toxic).[45] This category encompasses several of the most powerful classical anaesthetic agents including *Vatsanabha* (Aconitum), *Kuchala* (*Strychnos nux-vomica*), *Bhallataka* (*Semecarpus anacardium*), and *Dhatura* (*Datura metel*).

The *Shodhana* of *Vatsanabha* involves sequential processing through cow's urine (*Gomutra*), cow's milk (*Godugdha*), and boiling in specific herbal decoctions.

Contemporary pharmacological studies have demonstrated that this classical processing reduces total aconitine content by 80-95% while preserving a significant proportion of analgesic activity attributed to less toxic derivatives including benzoylaconine and aconine.[46] Critically, HPLC-MS analysis of classically processed *Shodhita Vatsanabha* has identified novel hydrolysis products not present in the raw drug that contribute to analgesic efficacy without attendant cardiotoxicity suggesting that classical physicians had empirically discovered the principle of structural modification of bioactive alkaloids through controlled processing, centuries before the conceptual framework of medicinal chemistry existed.[47] Similarly, *Shodhana* of *Kuchala* through repeated milk processing has been shown to reduce strychnine content by 60-70%, converting the preparation from a potentially lethal CNS stimulant to a clinically manageable analgesic at the doses prescribed in classical texts.[48]

The classical specification of qualitative endpoints for *Shodhana* completion changes in colour, odour, texture, and specific physical tests reflect an empirical quality assurance system that, while lacking modern analytical rigour, served the practical purpose of ensuring consistent processing across different practitioners and geographical locations. The development of validated quantitative analytical endpoints for *Shodhana* processes, using HPLC-MS, ICP-MS for heavy metals, and bioassay panels, represents one of the most urgent standardisation priorities in contemporary Ayurvedic pharmaceutical research.[49]

Classical Anaesthetic Complications and Management

The sophistication of classical Ayurvedic anaesthetic practice is perhaps most convincingly evidenced by the explicit recognition and systematic management of anaesthetic complications evidence of accumulated clinical pharmacovigilance that could only have arisen from extensive operative experience.[50] *Sushruta Samhita* describes complications of excessive *Madya* or *Sammohana* administration including respiratory depression (*Shwas avarodha*), complete loss of reflexes (*Sarva sangya nash*), and cardiovascular instability.[51] The prescribed antidotal strategies reveal the empirical pharmacological reasoning underlying classical practice: for opioid overdosage, vigorous physical stimulation, acidic substances, and pungent inhalations were prescribed strategies representing rational attempts to stimulate the CNS and counteract respiratory depression through sympathomimetic arousal.[52]

For anticholinergic toxicity from Datura overdosage, cold water immersion, diaphoretics, and physostigmine-containing plant materials were prescribed the latter representing a direct pharmacological counterpart to modern physostigmine use in anticholinergic toxidrome management.[53] For Cannabis intoxication, sweet and sour foods, cold water, and milk were prescribed interventions now understood to modulate endocannabinoid receptor activity through competitive substrate mechanisms. The existence of these detailed antidotal protocols demonstrates not merely awareness of adverse effects, but a sophisticated cause-effect understanding of drug mechanisms that belies any characterisation of classical Ayurvedic pharmacology as purely mystical or non-empirical.

Contemporary Research Evidence and Validation

The past three decades have seen substantial expansion in pharmacological research validating the mechanistic basis of classical Ayurvedic analgesic drugs. Cannabis-based medicines have received regulatory approval for pain management in multiple jurisdictions, with systematic reviews demonstrating modest but statistically significant analgesic efficacy in neuropathic pain.[54] *Datura* alkaloids scopolamine and atropine remain in routine clinical anaesthetic use as antisecretory premedications, validating the classical applications of *Parasika Yavani* and *Dhatura* in surgical contexts.[55] Aconitum derivatives have attracted significant interest as sodium channel modulators, with synthetic analogues being investigated as non-opioid analgesics for neuropathic pain conditions refractory to conventional therapy.[56]

Pharmacokinetic studies of classically processed *Shodhita Vatsanabha* have demonstrated that purification dramatically widens the therapeutic index, supporting the classical distinction between raw toxic and processed therapeutic forms and providing strong pharmacological justification for the mandatory *Shodhana* protocol.[57] Multimodal analgesic formulations combining Ayurvedic agents have been evaluated in randomised controlled trials for conditions including osteoarthritis, low back pain, and post-operative pain, with several demonstrating efficacy comparable to standard NSAIDs with favourable safety profiles.[58] Ginger (*Shunthi*, *Zingiber officinale*) has shown significant analgesic and anti-inflammatory activity in randomised trials for knee osteoarthritis, attributed to dual COX/LOX inhibition by gingerols and shogaols.[59] Boswellic acid preparations have demonstrated anti-inflammatory efficacy in osteoarthritis through mechanisms distinct from conventional NSAIDs, avoiding gastrointestinal adverse effects while producing clinically meaningful pain reduction.[60]

Yoga and *Pranayama* described in classical texts as important adjuncts to pharmaceutical pain management have accumulated substantial evidence for efficacy in chronic pain conditions including low back pain, fibromyalgia, and osteoarthritis, operating through neuromodulatory mechanisms including enhanced descending inhibitory pathway activity.[61] Panchakarma procedures, including *Basti* (medicated enema) and *Abhyanga* (therapeutic massage), have demonstrated analgesic and anti-inflammatory effects in clinical studies on rheumatoid arthritis and osteoarthritis patients, with proposed mechanisms including modulation of gut microbiome, reduction in pro-inflammatory cytokine levels, and activation of parasympathetic nervous system responses.[62]

Methodological Challenges in Research Translation

The translation of classical Ayurvedic anaesthetic knowledge into validated clinical practice is confronted by multiple systematic methodological challenges. First, botanical authentication: classical drug descriptions employ *Sanskrit* terminology that may encompass multiple related species or regional synonyms. Rigorous authentication using morphological, phytochemical, and DNA barcoding methods is indispensable.[63] Second, the classical dose specification problem: measures including *Tola, Karsha, Ratti,* and *Pala* have varied historically by region and dynasty, introducing uncertainty that may span orders of magnitude for smallest measures, fundamentally compromising dose-response calculations.[64] Third, the compound formulation challenge: multi-ingredient preparations create pharmacological profiles that cannot be predicted from single-ingredient studies; systematic combinatorial pharmacological and network pharmacology approaches are required.[65]

Fourth, the *Shodhana* standardisation challenge: classical purification processes are described using qualitative endpoints rather than quantitative chemical targets, making inter-laboratory standardisation extremely difficult without validated analytical methods. Fifth, ethical and regulatory constraints: several key classical anaesthetic drugs particularly *Datura* alkaloids, processed Aconite, and Opium derivatives are subject to stringent regulatory controls in most jurisdictions, creating substantial barriers to clinical pharmacological investigation [66]. Sixth, publication bias in Ayurvedic research: a significant proportion of positive trial outcomes for Ayurvedic interventions have been published in journals with limited peer review rigour, requiring cautious interpretation and independent replication before regulatory or clinical adoption.[67]

Future Research Directions

The research agenda should be structured across three priority tiers. In the immediate term (0-5 years): systematic botanical authentication and DNA barcoding of all major classical anaesthetic drugs; development of validated HPLC-MS analytical methods for key constituents; standardisation of *Shodhana* processes using quantitative chemical endpoints; and systematic dose-finding pharmacokinetic studies in animal models. In the medium term (5-10 years): randomised controlled Phase II trials of most promising preparations for specific pain conditions; systematic pharmacological evaluation of key compound formulations using network pharmacology; and integration of Ayurvedic analgesic formulations into multimodal perioperative analgesia protocols in academic centres with appropriate ethical oversight.

In the longer term (>10 years): large-scale Phase III comparative effectiveness trials of validated *Ayurvedic* analgesic regimens; investigation of classical alkaloids as novel analgesic drug candidates through systematic medicinal chemistry; and development of integrated Ayurvedic-biomedical perioperative care pathways validated against ERAS benchmarks in multicentre trials. The establishment of dedicated translational research centres with combined expertise in classical Ayurvedic scholarship, pharmacognosy, clinical pharmacology, and biomedical research represents the institutional prerequisite for achieving this agenda at the scale and rigour required.

CONCLUSION

The classical Ayurvedic tradition of *Sangyaharana* and *Vedana shamana* constitutes a sophisticated, coherent, and empirically grounded system of anaesthetic and analgesic practice developed over several millennia of surgical experience. The principal pharmacological agents employed Cannabis, Datura, Hyoscyamus, Papaver, Aconitum, and Strychnos preparations operate through well-characterised receptor-level mechanisms that fully account for their classical therapeutic descriptions, and their dose-dependent toxicity profiles were empirically recognised and managed through mandatory *Shodhana* processes and explicit antidotal protocols demonstrating clinical pharmacovigilance of a high order.

The *Tridosha*-based taxonomy of pain demonstrates conceptual congruence with modern pain pathophysiology classifications that transcends coincidence, suggesting that sustained clinical observation of pain phenomenology generates convergent conceptual frameworks across widely separated epistemological traditions. The *Shalya Tantra* perioperative protocol embodies functional equivalents of modern anaesthetic premedication, intra-operative management, and evidence-based post-operative recovery strategies. The pressing global challenges of opioid dependence, NSAID-associated morbidity, and unmet need for effective non-addictive

analgesics create an urgent case for systematic, scientifically rigorous investigation of this tradition.

With appropriate methodological rigour encompassing botanical authentication, phytochemical standardisation, mechanistic pharmacology, and well-designed clinical trials classical Ayurvedic anaesthetic and analgesic knowledge holds genuine potential to contribute novel drug candidates, formulation strategies, and integrated care protocols to the global therapeutic armamentarium for pain management. The convergence of ancient empirical wisdom and contemporary scientific methodology, far from representing a contradiction, offers one of the most productive frontiers in translational pharmacology available to the twenty-first century researcher.

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