



Original Research Article

Protocol based pain management by *Ayurveda* parasurgical procedures W.S.R to musculoskeletal pain and its critical appraisal – An open labeled clinical trial



Vibhuti Mishra, Pradeep S. Shindhe*, Ramesh S. Killedar

Dept of Shalya Tantra, KAHER's Shri B M Kankanawadi Ayurveda Mahavidyalaya, Shahapur, Belagavi, Karnataka, India

ARTICLE INFO

Article history:

Received 9 May 2020

Received in revised form

22 April 2022

Accepted 10 October 2022

Available online xxx

Keywords:

Pain management protocol

Para surgical procedure

Agnikarma

Cupping therapy

Leech therapy

Siravyadha

ABSTRACT

Background: Pain has globally become an attention problem which causes discomfort by affecting the body as well as the mind. The International association of pain estimated that 1 in 5 patients experiences the pain, i.e. 30% of world population. 19.3% (180–200 million) of the total population in India suffer from chronic pain and its severity appeals early approach of patients to hospitals. *Ayurveda* being the oldest medical science emphasized its importance and treatment of pain with both pharmacological and non-pharmacological (Parasurgical) methods.

Objective: To evaluate the efficacy of non-pharmacological (para surgical) procedures in the management of pain.

Materials and method: Total 100 patients with chronic musculoskeletal pain fulfilling the inclusion criteria were recruited by assessing the site, severity and nature of pain. A special protocol was framed by incorporating *Ayurveda* treatment principles by using Para surgical procedures such as *Agnikarma* (Therapeutic burn), *Jalauka* (leech therapy), *Alabu* (Cupping therapy) and *Siravyadha* (Vein puncture). The parameters like VAS and VDS pertaining to pain were assessed from baseline and at various time points. Statistical analysis was performed by using Wilcoxon match paired test to assess the results.

Results: The VAS and VDS scale were used to assess the efficacy of para-surgical procedures which was found to be significant ($p < 0.0001$) from baseline and at various time points.

Conclusion: Protocol based pain management by various para surgical procedures was found effective in the management of chronic musculoskeletal pain. The ambiguity in selection of proper parasurgical procedure for pain management is justified by following the protocol.

© 2022 The Authors. Published by Elsevier B.V. on behalf of Institute of Transdisciplinary Health Sciences and Technology and World Ayurveda Foundation. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

1. Introduction

Pain is understood as the pointer symptom of various disease conditions which affects the patient quality of life in terms of impairment in physical functioning and mental status. It has emerged as the top most field of research due to its challenging management as well as conceptual understanding [1]. Various hypotheses have been proposed from ancient times till now, but its understanding is still a venture for the research area. *Acharya Sushruta* has explained various causative factors of pain, i.e. *Sharirika* (body), *Manasika* (mind) and *Agantuja* (External) which makes

the patient feel destitute even after being delimited by many means of emotional aids [2]. Pain has many definitions, features and classifications with numerous remedies; however, precise management is the need of the hour. The International Association for the Study of Pain estimates that 1 in 5 patients experience pain and 1 in 10 patients are diagnosed every year [3]. The Prevalence of chronic pain in India is 19.3% (180–200 million) of the total population and further there is no availability of published data on acute pain [4]. Previous researches have opined that there are two types of pain in which acute pain is a good symptom which indicates the body to notice (help for prognosis), while the chronic pain is bad pain with longer duration which makes the person to suffer a lot. The Chronic pain, mostly occurs in the musculoskeletal and joint disorders leading to disability with the increasing worldwide disease burden [5]. Pain management is one of the

* Corresponding author.

E-mail: pshindhe@gmail.com

Peer review under responsibility of Transdisciplinary University, Bangalore.

incipient challenges in the field of medical research. Currently opioids and NSAIDs are administered for its management, but prolonged use of these drugs has hepato- Renal toxic effects and recessive actions on the body [6,7]

The non-pharmacological treatment modalities are high spots need for management of pain [8]. The treatment of diseases is divided into two components based on the condition, i.e. *Aatyayika* (Emergency) and *Vyadhipratyanika* (disease modifying) *chikitsa*. *Aatyayeeeka chikitsa* mainly includes non-pharmacological treatments i.e. various parasurgical procedure like *Agnikarma* (therapeutic cautery- TC), *Jalaukavacharan* (Leech therapy- LT), Cupping therapy (CP), *Siravyadha* (Vein puncture- VS) which helps in the initial management of pain [9].

Researchers have explored various usages of parasurgical methods in managing different clinical condition but still clear conclusion of selecting treatment modality in relation to pain is concern of the research. Hence, in the present study, an attempt was made to simplify the use of Parasurgical procedures by framing the protocol for pain management.

2. Material and methods

The patients complaining of musculoskeletal pain as the main symptom of different disease origin like Sciatica, Frozen shoulder, Lumbago, Cervical pain, Calcaneal spur, Plantar fasciitis, Osteoarthritis, Buerger's disease (Thromboangitis obliterans), Varicose vein, Rheumatoid arthritis was selected. The patients attending OPD and IPD of our institute were enrolled for the purposed study and written informed consent was taken before recruitment. The CONSORT statement guidelines were followed for reporting the outcomes of the study. The Study was approved by the Institutional Ethics Committee (Protocol Id- BMK/17/PG/SL/6, KAHER BMK Ayurveda Mahavidyalaya Belagavi, CTRI registration number- CTRI/2018/07/014962). Data collection was done from November 2018 to December 2019. The patients were observed for any adverse events and were systemically recorded during the study period.

2.1. Subject

Total 100 patients diagnosed with chronic musculoskeletal pain as per inclusion criteria were enrolled in the study.

2.2. Sample size calculation

The sample size was calculated with level of significance for 95%, i.e. 1.96, power for 80%, i.e. 0.84. Mean of VAS scores and standard deviation were taken from the previous published research works. 20% of dropouts were anticipated and calculated with a formula $n = [(Z_{\alpha/2} + Z_{\beta})^2 \times \{2(\hat{\sigma})^2\}] / (\mu_1 - \mu_2)^2$ which turned out to be 84, so 100 patients were recruited considering the dropouts as it was single arm trial [10–12].

2.3. Inclusion criteria

The patients with chronic musculoskeletal pain with more than 6 months duration and either sex with age 18 to 60 years were included in the study.

2.4. Exclusion criteria

The patient with a history of headache, pain in the chest, abdomen, Groin Region, Postoperative Pain, Pregnancy, recently underwent *Panchakarma procedures* (*Vamana*, *Virechana*, *Asthanpana*, *Anuvasanabasti*) were excluded. Patients with a major systemic illness like Anemia, Cancer, Tuberculosis, Heart Diseases,

HbsAg etc. Patients on Opioid, Anticoagulant Drugs, Anti platelet drugs, having febrile condition and classically contra-indicated patients for *Agnikarma* or *Raktamokshana* were excluded from the study [10,11].

2.5. Screening method

Patients with chronic musculoskeletal pain were screened as per the inclusion and exclusion criteria. Patients fulfilling the criteria were recruited for the study and presented in the form of a consort chart (Fig. 1).

2.6. Study design

The study was an open labeled clinical trial, subjects were enrolled through specially framed pain management protocol (Fig. 2) [12–16]. The data were recorded systematically and analyzed using appropriate statistical methods.

2.7. Intervention

Parasurgical procedures were performed as per the SOP prepared according to NABH policies and procedures for Ayurveda hospital. Required prerequisites like preoperative preparation and postoperative care measures were incorporated for each intervention. Interventions were performed only once, i.e. on the day of enrollment. The nature and design of the study were explained to the patients and informed consent was taken.

Agnikarma – The procedure was performed by selecting appropriate *dahanopakarana* with reference to the *dhatu* level. Heated *Pippali* was used in *twakgata* condition, *Panchaloha shalaka* was used in *mamsa* condition, *Tapta Guda* (Heated Jaggery) *agnikarma* was done with specially designed instrument in *sandhi* and *asthi* condition. *Bindu* type of *agnikarma* was performed in all the disease condition (Fig. 3).

Raktamokshana – SOP of the procedures (Leech therapy, *Siravyadha*, Cupping) along with assessment chart is attached as supplementary material.

2.8. Criteria for assessment

VAS (Visual analogous scale) and VDS (Visual descriptive scale) were used to assess the pain before, immediately after the procedure and at various intervals, i.e. 1st hour, 2nd hour, 3rd hour, 6th hour and 24th hour, follow up was done on 5th and 10th day from the day of enrollment. Safety measures were taken care by performing bleeding and clotting time in all the patients before *Raktamokshana*.

2.9. Statistical methods

The changes in VAS and VDS scale were compared from baseline to different time points, i.e. immediately after the procedure, 1st hour, 2nd hour, 3rd hour, 6th hour, 24th hour, 5th day and on 10th day by using Wilcoxon match paired test (Table no.1). Values were reported as mean \pm standard deviation and all tests were considered statistically significant at $p < 0.05$.

3. Results

A total of 100 patients completed the study and there was no dropouts. No adverse events were encountered during the study.

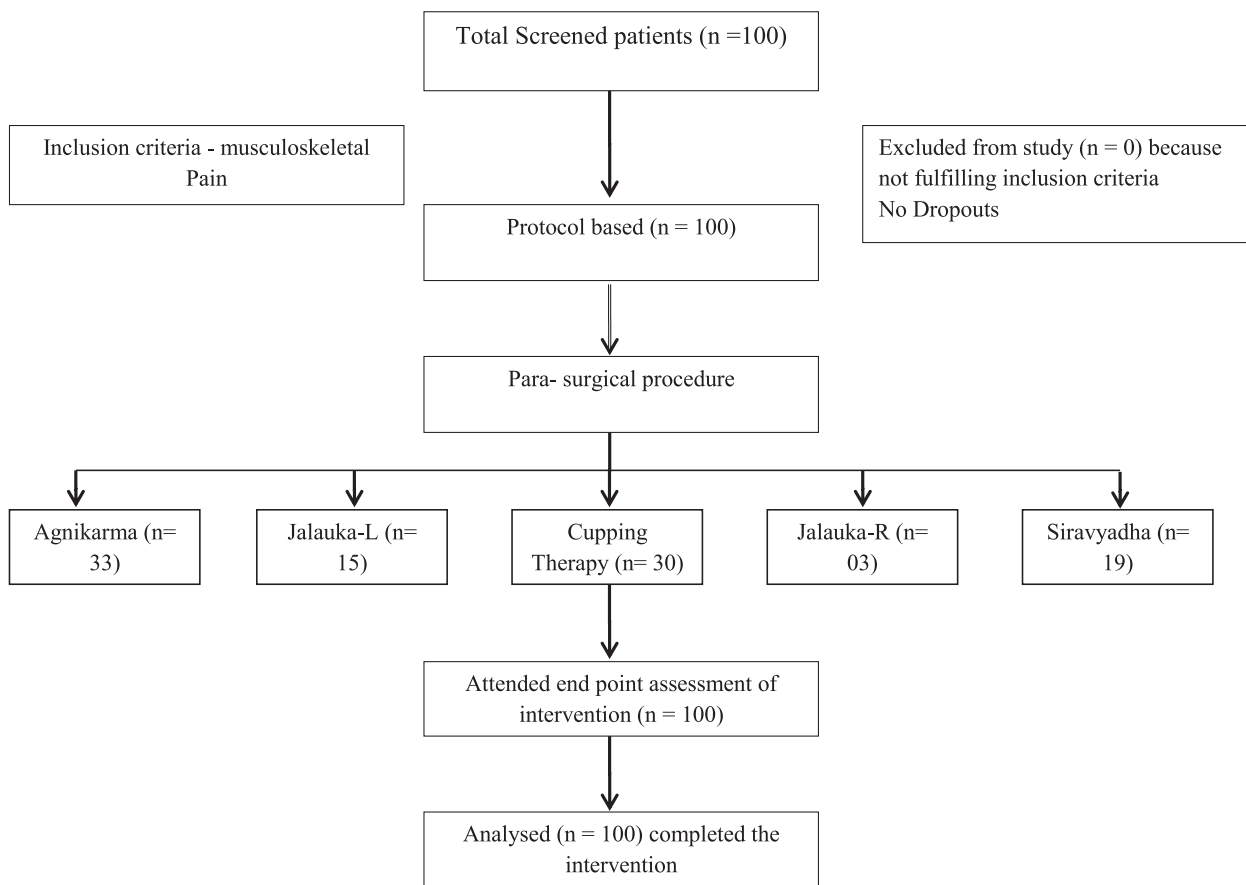


Fig. 1. Showing Consort flow chart of the clinical study.

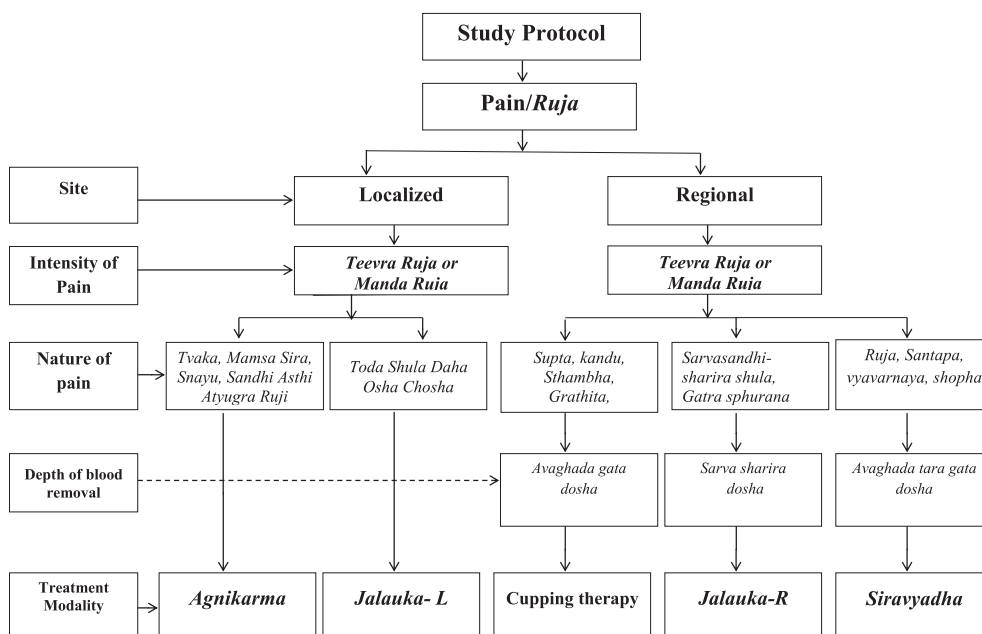


Fig. 2. Showing flow chart of the designed protocol for pain depending upon to site, severity, nature and with relation to tissue involved.



Agnikarma with Panchaloha Shalaka

Agnikarma with Tapta Guda

Fig. 3. Agnikarma with different Dahanopakarana.

3.1. Subject characteristics

Age – 10% of the patients were belonging to the age group of 20–30, 25% from 31 to 40, 28% from 40 to 50, 36% from 50 to 60 group.

Sex – 39% of the patients were male and 61% were female.

Parasurgical Procedures – total procedures performed in the present study i.e. Agnikarma (33), leech therapy (18), Cupping therapy (30), Siravyadha (19) (Table 1).

3.2. Primary outcomes

3.2.1. Localized pain

Agnikarma (TC) procedure showed significant result (p = 0.0001) in reducing pain immediately after the procedure and at different time intervals (p = 0.0001) in both VDS and VAS scale. Leech therapy (LT) showed significant results immediately after the procedure (p = 0.0010) and at different time intervals (p = 0.0007) in both VDS and VAS scale (Table 1).

3.2.2. Regional pain

In Regional pain, Cupping therapy (CT) showed significant result in reducing pain immediately after the procedure (p = 0.0001) and

at different time intervals (p = 0.0001) in both VDS and VAS scale. In Leech Therapy for regional pain the results were clinically appreciated with an immediate reduction in the baseline, due to less patients ‘p’ value was not obtained. In Siravyadha (VP) group, it showed similar significant pain reduction immediately after the procedure (p = 0.0003) and at different time intervals, i.e. 1st hour (p = 0.0003), 2nd hour, 3rd hour (p = 0.0002), 6th hour (p = 0.0001), 24th hour (p = 0.0001) and on the 5th day (p = 0.0001) (Table 1).

4. Discussion

In a clinical trial, protocol framing plays a pivotal role in designing and implementation of the experimental or clinical practices. A properly designed protocol, based on the classical background provides an easy understanding, reduces the bias in the selection of the patients and procedures. The adapted protocol provides an insight in the selection of pain and parasurgical procedures, thus aiding the clinical practitioners to rationalize the treatment outcome.

Interpretation of various procedures with localized and regional pain - In Ayurveda literature various characteristics of pain are mentioned in relation to site, severity, nature and with the tissue involved. After meticulous analyzing the indications of

Table 1
Showing results of reduction in pain in different interval of time.

Procedure Done	Subject enrolled (n)	Treatment time	Baseline (mean ± SD)	Immediately after	1 st hour after	2 nd hour after	3 rd hour after	6 th hour after	24 th hour after	5 th day	10 th day
Agnikarma (Therapeutic Thermal cautery)	33	VAS	7.21 ± 0.89	3.36± 1.32***	3.48± 0.80***	3.24± 1.03***	3.24± 1.00***	3.09± 0.95***	3.30± 1.10***	4.36 ± 1.42***	7.01 ± 0.88
		VDS	7.21 ± 0.89	3.36± 1.32***	3.24± 1.06***	3.42± 0.97***	3.55± 0.83***	3.48 ± 0.87***	3.30± 1.10***	4.47 ± 1.32***	7.10 ± 0.76
Jalauka 1 (Leech) in severe pain	15	VAS	7.27± 1.22	4.60± 1.55***	4.47± 1.30***	4.33± 1.23***	4.20± 1.37***	3.73± 1.33***	3.53± 1.46***	5.60± 1.45***	7.15± 1.12
		VDS	7.27± 1.22	4.60± 1.55***	4.47± 1.30***	4.40± 1.24***	4.40± 1.40***	3.67± 1.40***	3.53± 1.46***	5.62± 1.35***	7.03± 1.13
Jalauka 2 (Leech) in moderate to mild pain	03	VAS	5.67± 1.15	2.67± 1.53	2.33± 1.53	2.33± 1.53	2.33± 1.53	1.67± 0.58	1.67± 0.58	3.76± 1.23	5.32± 1.25
		VDS	5.67± 1.15	2.33± 1.53	2.33± 1.53	2.33± 1.53	1.67± 0.58	1.67± 0.58	1.67± 0.58	3.53± 1.34	5.50± 1.05
Alabu (Cupping therapy)	30	VAS	6.27± 0.78	2.67± 1.09***	2.73± 1.01***	2.73± 1.05***	2.77± 1.04***	2.67± 0.88***	2.67± 0.88***	4.54± 1.18***	6.16± 0.65
		VDS	6.27± 0.78	2.67± 1.15***	2.73± 1.05***	2.70± 1.06***	2.83± 0.99***	2.73± 0.83***	2.67± 0.88***	4.68± 1.23***	6.12± 0.66
Siravyadha (Venous section)	19	VAS	7.11± 0.81	4.11± 1.59***	4.05± 1.39***	3.74± 1.28***	3.68± 1.25***	3.42± 0.69***	3.16± 0.69***	4.23± 1.38***	7.02± 0.79
		VDS	7.11± 0.81	4.11± 1.59***	3.84± 1.21***	3.68± 1.38***	4.00± 1.33***	3.63± 1.07***	3.16± 0.69***	4.38± 1.46***	7.05± 0.77

*p < 0.05, **p < 0.01, ***p < 0.001.

parasurgical procedures it can be concluded that, these indications are in relation with the characteristic of the pain, *dosha* (bodily humours), *dushya* (tissue depth), intensity. *Agnikarma* (TC) procedure is specified in *Atyugraruje* (intense pain) occurring at various level from skin to bones for which *dahanopakarana* (heating instruments) and *dahana vishesha* (cautery tip) i.e. *valaya* (blunt) and *bindu* (pointed) are stated [13]. TC is preferred, whenever the pain is with higher intensity and localized, except in *pittaja prakruti* and *pittaja kala* [11].

In the contemporary science chronic pain (maldynia) is explained as reoccurring or unremitting. Pain exists as an abnormal experience indicating that something has gone seriously wrong and the tissue is abnormal in its composition (Chronic inflammation/Inflammatory soup) forming a pathological entity [17]. *Raktamokshana* means elimination of vitiated blood from extracellular (trans-cellular and intravascular) compartments, the vitiated blood can be correlated to the inflammatory soup [18]. Ayurveda treatment principles are based on eradication of root cause for every disease entity. *Raktamokshana* procedure plays vital role in eliminating the root cause of pain and hinders the disease progression through nearest route. The various methods of *raktamokshana* are *Jalauka* (leech therapy), *Alabu* (cupping therapy) and *Siravyadha* (Vein puncture), these procedure are explained according to involvement of *dosha* i.e. *pitta dosha* (LT), *Kapha-vata* (cupping therapy), and *tridoshaja* (*Siravyadha*) [19]. Based on the nature of pain, i.e. *daha* (LT), *grathita* (CT), *sthamba* (CT), *gatrashpurana* (VS), *sarvasharira shula* (VS) etc. Based on the level of *dosha-dushya sammurchana* i.e. *Avaghada* (LT), *Avaghadata* (CP), *Avaghada tama* (VP) and area of drainage of vitiated blood i.e. LT (1 *hasta pramana*), CP (12 *angula*) and VP (*sarva sharira*) [20]. Based on the above factors, it can be implicated that *raktamokshana* is effective for regional pain. LT is exceptional because of its indication in the nature of pain like *toda*, *oosha*, *chosha*, *paridaha*, it can be beneficial in both localized as well as regional pain [20].

4.1. Agnikarma (Therapeutic cautery)

In localized chronic pain, TC showed significant results by reducing it immediately after the procedure and at different time points (Table 1). *Agnikarma* is indicated for pain at various level of *dhatu* i.e. skin to bone and in *atyugraruja* (intense pain) [20] [8] which establishes presence of free nerve endings from superficial layer of the skin, muscle, arterial walls, periosteum and joint surfaces as per contemporary science [21,22]. Intense pain is carried out by A- δ fibers through spinothalamic tract and moderate to mild

pain is carried out by C-fibers through paleo-spinothalamic tract [22]. The pain which originate from deeper structures usually carried by primary smaller diameter fibers (A- δ and C-fibers). The rationality behind mentioning of 10 *dahanopakarana* (heating material) for different levels of *dhatu* holds good because the pain originated from superficial to deeper *dhatu* are addressed with different heating material which differs in latent heat (heat carrying capacity) and heat dissipation of the materials mentioned [20,23]. *Agnikarma* with its thermal effects acts over the larger diameter A- β fibers and leads to the inhibition of pain signals transmitted via smaller diameter (A- δ and C-fibers) thus closing the physiological gate of pain following Gate control theory [24,25]. Another hypothesis stated that heat transmitted at different tissue level generates vasodilation response causing increase in the blood circulation there by evacuating metabolic waste which is responsible for localized pain relief. [26]. In addition to this diffuse noxious inhibitory control theory explains that one pain masks other pain on stimuli which was evident by *Agnikarma* in localized pain at different tissue level [27].

4.2. Raktamokshana (bloodletting)

4.2.1. Jalaukavacharan (Leech therapy)

The *Jalaukavacharana* is bloodletting procedure using medicinal leeches which showed significant results in the reduction of localized along with as well as regional pain in both severe and mild to moderate intensity (Figs. 4 and 5). Characteristics like *toda* (pricking), *osha* (burning), *chosha* (sucking), *paridaha* (burning whole part), *shopha* (swelling), *santapa* (warmth) and *vaivarnya* (discoloration) are the cardinal signs generated by *pitta dosha* which can be well correlated to classical signs of inflammation i.e. temperature, pain, redness, swelling and loss of function [28–30]. Inflammatory soup is formed by inflammatory mediators released by pathogen-associated molecular patterns (PAMPs) and damage-associated molecular pattern (DAMPs) [31]. The burning type of pain is resulted from inflammatory soup (substance p, CGRP, Bradykinin etc.) due to changes in chemical environment causing peripheral sensitization of free nerve fibers embedded in the extracellular matrix of the tissue [17,18,32]. The interstitial edema occurs due to vascular phase, which initiates the vasodilation and increases the permeability leads to outpouring of inflammatory mediators from the vessel into interstitial tissue [33]. The edema with inflammatory features for short duration generates acute pain and persistent pathologies lead to chronic pain in future [34].

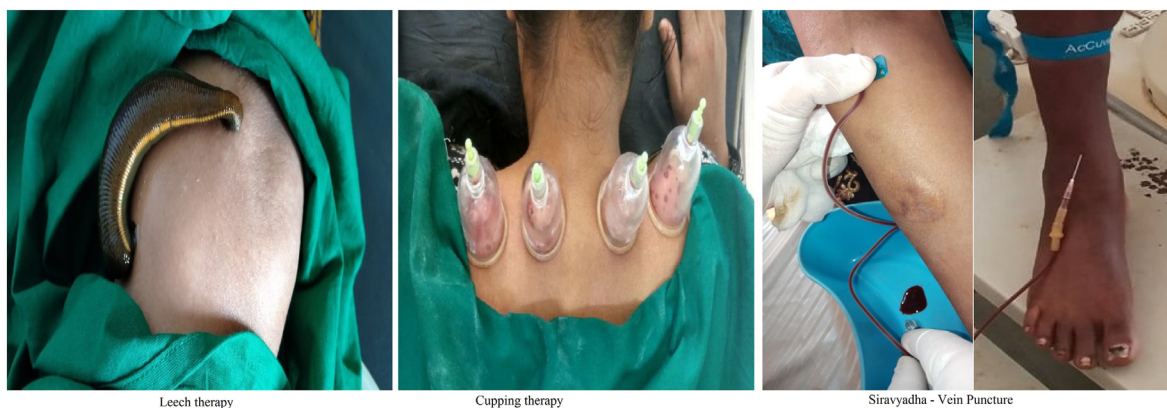


Fig. 4. Various types of Raktamokshana (Blood letting).

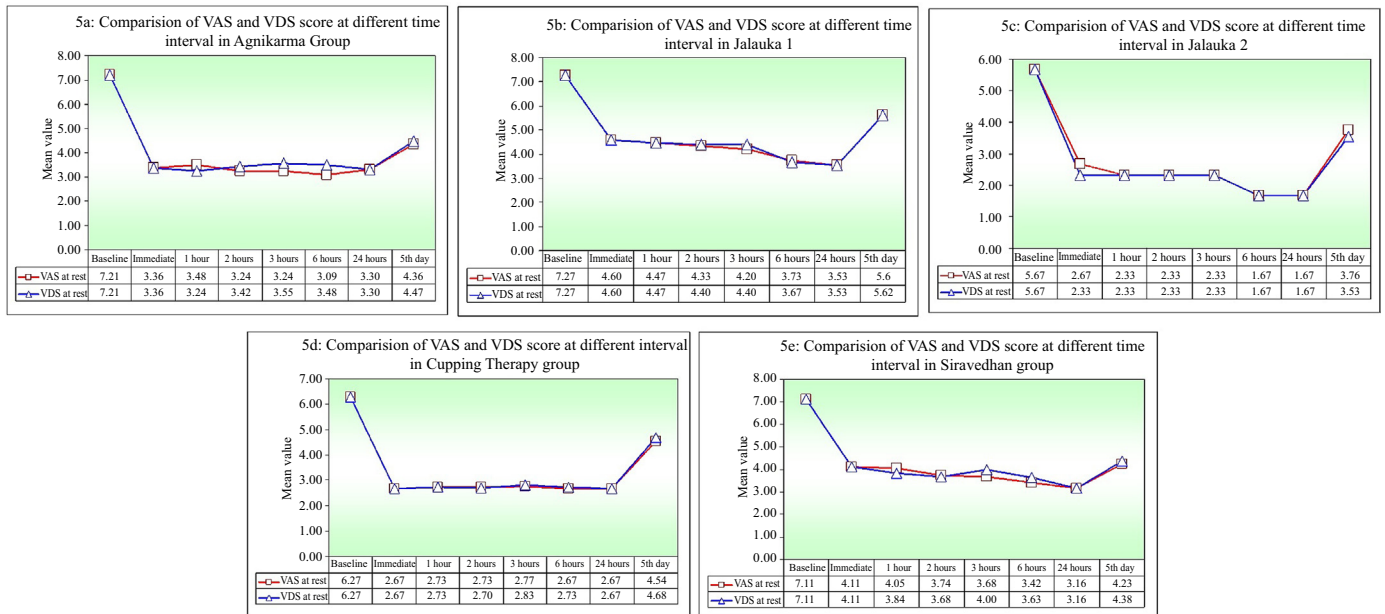


Fig. 5. Graphs showing results of Agnikarma and Raktamokshana. a) Comparison of VAS and VDS score at different time interval in Agnikarma Group. b) Comparison of VAS and VDS score at different time interval in Jalauka 1. c) Comparison of VAS and VDS score at different time interval in Jalauka 2. d) Comparison of VAS and VDS score at different time interval in Cupping Therapy group. e) Comparison of VAS and VDS score at different time interval in Siravedhan group.

In leech therapy the vitiated blood is sucked by the suction discs of leech, which acts over the extracellular matrix as well as surrounding vessels withdrawing the inflammatory soup thus reducing the burning type of pain [35]. It also reduces the mechanical loads of the tissue present in vascular and cellular level and diminishes the pain [35].

Antistatin present in the saliva of the leech acts over kinin-kallikrein mechanism where inflammatory conditions causes release of bradykinin and other mediators leading to inflammatory type of pain [36,37]. Research study states that inflammation and swelling create areas of stasis in the tissue where pH drops to 5.0 and extracellular environment becomes acidic as an increase in proton concentration [H+] [36–38]. Leech therapy removes the blood with the extracellular component, thus helps in reducing the acidic value and subsiding burning type of pain which can be well correlated with usage of LT in Pittaja shotha [28]. All the above facts prove that the practice of LT is effective in both localized and regional pain with characteristic features of inflammation.

4.2.2. Cupping Therapy (CT)

It is the most popular ancient therapy of bloodletting [39]. CT has shown significant results in severe and moderate to mild regional pain from baseline to different time intervals (Table 1, Figs. 4 and 5). In Ayurveda it is elucidated as Alabu/or Ghati yantra karma mainly indicated in Kapha-vata dosha and Avaghadatara dushta rakta [19,20]. It acts over the pain with characteristics like sthamba (restricted), grathita (tighten, stiffness), supta (numbness) and chimchimayana (tingling sensation). These types of pain generally originate from musculoskeletal system and are termed as myofascial pain. The pain of these types is associated with the release of inflammatory cytokines causing stiffness, pain on deep palpation, referred pain and restricted range of joint movements [40]. CT evacuates the blood from the vascular system and surrounding tissue of extracellular matrix with inflammatory cytokines, which helps in the reduction of pain [39,41]. It dilates topical capillaries and increases dermal blood flow with activation of the immune system which produces comfort and relaxation of the

musculoskeletal system. CT reduces the dull aching pain which is mainly caused by the tightening of muscle spindles, it enhances blood circulation, removes noxious materials from the skin, improves microcirculation, promotes capillary endothelial cell repair, accelerates granulation and angiogenesis in the regional tissues, thus helps in progressive muscle relaxation and pain reduction [39]. Regional pain is managed due to the procedure of wet cupping, where multiple pricks are done at localized area which masks the pain sensation by generating inhibitory mechanism which could be well understood by diffused noxious inhibitory control mechanism [27,43]. Bloodletting results in the increase of endogenous opioid production, which in turn leads to control of pain [42].

4.2.3. Siravyadha (Vein puncture)

Siravyadha has shown significant results, immediately after procedure and at different time points in regional pain having with severe, and moderate to mild pain with characteristic of sarva sharirashula (pain all over the body), gatra shpurana (radiating pain), sandhi shula (joint pain), guruta (heaviness)(Figs. 4 and 5). These symptoms were found in pathologies like Chronic venous insufficiency i.e. Varicose vein, Deep vein thrombosis (DVT), Peripheral Arterial diseases (TAO). Early stage of inflammation in these diseases occurs due to presence of leukocytes obstructing post capillaries and venules partially or completely in a larger area, which remain uninterrupted for long duration and produces symptoms such as heaviness, throbbing and radiating pain. Adenosine is released due to inflammation which causes vasodilatation leading to plasma extravasation and stagnation of toxic substance, antigens in the vascular region [43]. Blood removal with aseptic precautions from the superficial prominent veins helps in reduction of pain originated by vascular pathology [19].

Chronic neurogenic inflammation is mediated by CGRP and substance 'P' from nociceptors, which directly act on vascular endothelial and smooth muscle cells, leading to vascular pathologies [33] [44] [45] [46] [48]. It can be correlated to condition like Sciatica, where the pathology is caused by the peripheral

sensitization of nerve fibers which is responsible for generating neuropathic type of pain. This process of inflammation in the affected region of the body leads to mild, moderate and severe pain resulting in pathologies like neurodegenerative disorders (metabolic disorders, nerve ischemia, nerve compression), peripheral vascular disease (varicose veins, DVT). Vein puncture helps in removal of inflammatory agents and chemical mediators present in large amount like bradykinin, histamine, serotonin, substance-P and leukocytes. Previous researches proved that blood detoxification theory in which the removal of old red blood cells and obstruction from the blood promotes removal of toxins, improves the nutrition status and boost up the metabolic process by providing good blood circulation [33,34]. VP is described as *Ardhachikitsa* according to *Acharya Sushruta* which emphasizes its action on various neurological and vascular pathologies.

In the present study all the Para surgical procedures were intervened for a single time. Pain was reduced up to 5th day and increase in the intensity was observed on the 10th day so a single attempt of these procedures may yield temporary relief. In clinical practice minimum of 3 sittings are commonly used for pain relief so in the present study an attempt was made to validate the reuse of procedures at a specific time period.

5. Conclusion

The framing of the protocol was planned by incorporating principles of Para surgical procedures and different characteristics of pain (Local and Regional). The results were assessed under the heading of localized and regional pain which specify the pain location, intensity, character and depth of tissue involved. The protocol was found to be safe and effective in the reduction of the pain immediately and at different time points. Multiple sittings of Para surgical procedures and *Panchakarma* procedures are necessary to provide sustained relief and to make it a significant solution but not a temporary measure of pain relief. Applicability of Para surgical procedure in both localized and regional pain reflects the similarity of *Ayurveda* principles with modern pain acceptance theories.

Author contribution

Concepts; Vibhuti Mishra, Shindhe Pradeep S, Ramesh Killedar, Design; Vibhuti Mishra, Shindhe Pradeep S, Ramesh Killedar, Definition of intellectual content; Vibhuti Mishra, Ramesh Killedar, Literature search; Vibhuti Mishra, Shindhe Pradeep S, Ramesh Killedar, Clinical studies; Vibhuti Mishra, Shindhe Pradeep S, Data acquisition; Vibhuti Mishra, Shindhe Pradeep S, Data analysis; Vibhuti Mishra, Shindhe Pradeep S, Ramesh Killedar Manuscript preparation; Vibhuti Mishra, Shindhe Pradeep S, Manuscript editing; Vibhuti Mishra, Shindhe Pradeep S, Ramesh Killedar, Manuscript review; Vibhuti Mishra, Ramesh Killedar, Guarantor; Vibhuti Mishra, Shindhe Pradeep S, Ramesh Killedar Other; Vibhuti Mishra

Source of funding

None.

Conflict of interest

We wish to confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced its outcome.

Acknowledgement

Dr. Suhas Kumar Shetty, Principal, KAHERS Shri B.M. Kankana-wadi Ayurveda Mahavidhyalaya, Shahapur, Belagavi.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jaim.2022.100665>.

References

- [1] Mularski RA, White-chu F, Overbay D, Miller L, Asch SM, Ganzini L. Measuring pain as the 5th vital sign does not improve quality of pain management. 2006. p. 607–12. <https://doi.org/10.1111/j.1525-1497.2006.00415.x>.
- [2] Acharya Sushruta. Sutrasthana. In: Shastri K, editor. *Susruta samhita*. Varanasi: chaukhambha Sanskrit sansthana; 2014. p. 4.
- [3] Goldberg DS, Mcgee SJ. Pain as a global public health priority. BMC Public Health 2011;11:770. <https://doi.org/10.1186/1471-2458-11-770>.
- [4] Saxena A, Jain P, Bhatnagar S. The prevalence of chronic pain among adults in India. Indian J Palliat Care 2018;24:472. https://doi.org/10.4103/IJPC.141_18.
- [5] Blyth FM, Briggs AM, Schneider CH, Hoy DG, March LM. The global burden of musculoskeletal pain—where to from here? Am J Public Health 2019;109:35–40. <https://doi.org/10.2105/AJPH.2018.304747>.
- [6] Slater D, Kunnathil S, McBride J, Koppala R. Pharmacology of nonsteroidal antiinflammatory drugs and opioids. Semin Intervent Radiol 2010;27:400–11. <https://doi.org/10.1055/s-0030-1267855>.
- [7] Byron Cryer. NSAID-associated deaths: the rise and fall of NSAID-associated GI mortality n.d.
- [8] Demir Y. Non-pharmacological therapies in pain management. Pain manag. - curr. Issues opin.. InTech; 2012. <https://doi.org/10.5772/30050>.
- [9] Sootra sthana. In: Datta Shastri Ambika, editor. *Samhita sushruta of sushruta*. Reprint. Varanasi: chaukhambha Sanskrit sansthana; 2014. p. 39.
- [10] Sakpal TV. Sample size estimation in clinical trial. *Perspect Clin Res* 2010;1:67–9.
- [11] Gupta S, Rajagopala M, Bhuyan C, Bakhshi B. A comparative study of agni karma with lauha, tamra and panchadhatu shalaka in gridhrasi (sciatica). AYU (An Int Q J Res Ayurveda) 2010;31:240. <https://doi.org/10.4103/0974-8520.72408>.
- [12] Kumbhare-Patil M, Gahukar D, Patil S. Role of raktamokshana by Ghati yantra in treatment of gridhrasi (sciatica): a pilot study. AYU (An Int Q J Res Ayurveda) 2016;37:26. https://doi.org/10.4103/ayu.ayu.212_15.
- [13] sutrasthana Acharya Sushruta. Kaviraja ambika data shastri. In: *Sushruta samhita*. Varanasi: chaukhambha sanskrita sansthana; 2014. p. 19.
- [14] Datta Shastri Ambika, editor. *Sutrasthana*. *Samhita sushruta of sushruta*. Varanasi: chaukhambha Sanskrit sansthana; 2014. p. 53.
- [15] Acharya Sushruta. No Title12. edition asthana p. In: Shastri K ambika data, editor. *Sushruta samhita*, Varanasi: chaukhambha Sanskrit sansthana; n.d., p. 70.
- [16] Acharya Sushruta. sutrasthana. In: Datta SA, editor. *Susruta samhita*. 2014th. Varanasi: chaukhambha Sanskrit sansthana; 2014. p. 52.
- [17] Sastri KCG, editor. *Charaka samhita*, vol. 1. Varanasi: Chaukhambha bharti academy; 2015. p. 825.
- [18] Sastri KCG, editor. *Chikitsa sthana*. *Charaka Samhita*, Varanasi: Chaukhambha bharti academy; 2015.
- [19] 16. Sastri K CG. *vatavyadhichikitsita adhyaya*. *Charaka samhita agnivesha revis*. By charaka drdhabala. Chaukhambha bharti academy Varanasi; 2015. p. 696.
- [20] *Integrative pain medicine*. Humana Press; 2008. <https://doi.org/10.1007/978-1-59745-344-8>.
- [21] Basbaum AI, Bautista DM, Scherrer G, Julius D. Cellular and molecular mechanisms of pain. *Cell* 2009;139:267–84. <https://doi.org/10.1016/j.cell.2009.09.028>.
- [22] 19. Kaviraja ambika data shastri. *Shariesthana*. *Susruta samhita of Maharsi Susruta*. Varanasi: chaukhambha Sanskrit sansthana; 2014. p. 92.
- [23] kasture HS. *Panchkarma vigyan*. 6th ed. Nagpur: shri Vaidyanath ayurveda bhavana lim.; 1999.
- [24] JE 23. Hall. Guyton and Hall textbook of medical physiology. 12th ed. USA: Saunders; [n.d].
- [25] Nagi SS, Marshall AG, Makdani A, Jarocka E, Liljencrantz J, Ridderström M, et al. An ultrafast system for signaling mechanical pain in human skin. *Sci Adv* 2019;5. <https://doi.org/10.1126/sciadv.aaw1297>.
- [26] Bagi HM, Shinde PS. Rationality behind Acharya Sushruta 's approach towards therapeutic agnikarma. *Indian J Appl Res* 2015;5:387–90.
- [27] Amarprakash D, Mumbai N, Pradnya C. Pain management through Ayurveda : a international pain management through Ayurveda : a meticulous review. 2019.
- [28] Saito N, Shima R, Yamada Y, Nagaoka M, Ito E, Yoshioka T. A proposed molecular mechanism for physical analgesia in chronic pain. *Neural Plast* 2018;2018. <https://doi.org/10.1155/2018/1260285>.
- [29] Tepperman PS, Devlin M. The therapeutic use of local heat and cold. *Can Fam Physician* 1986;32:1110–4.

- [30] Le Bars D, Gozariu M, Cadden SW. Animal models of nociception. *Pharmacol Rev* 2001;53:597–652. <https://doi.org/10.1002/9783527611942.ch9>.
- [31] Datta SA, editor. *Sootra sthana. Susruta samhita of maharsi susruta*. Varanasi: Chaukhambha Sanskrit Sansthan; 2014. p. 70.
- [32] Ferrero-Miliani L, Nielsen OH, Andersen PS, Girardin SE. Chronic inflammation: importance of NOD2 and NALP3 in interleukin-1 β generation. *Clin Exp Immunol* 2007;147:227–35. <https://doi.org/10.1111/j.1365-2249.2006.03261.x>.
- [33] Scholz J, Woolf CJ. Can we conquer pain? *Nat Neurosci* 2002;5:1062–7. <https://doi.org/10.1038/nn942>.
- [34] Coleman JF. Robbins and Cotran's pathologic basis of disease. 8th ed., vol. 34; 2010. <https://doi.org/10.1097/pas.0b013e3181bc5f0f>.
- [35] Colloca L, Ludman T, Bouhassira D, Baron R, Dickenson AH, Yarnitsky D, et al. Neuropathic pain. *Nat Rev Dis Prim* 2017;3:1–20. <https://doi.org/10.1038/nrdp.2017.2>.
- [36] Abdulkhaleq LA, Assi MA, Abdullah R, Zamri-Saad M, Taufiq-Yap YH, Hezme MNM. The crucial roles of inflammatory mediators in inflammation: a review. *Vet World* 2018;11:627–35. <https://doi.org/10.14202/vetworld.2018.627-635>.
- [37] Fessler Michael B, Rudel Lawrence L, Brown M. 基因的改变 NIH public access. *Bone* 2008;23:1–7. <https://doi.org/10.1038/jid.2014.371>.
- [38] Kampowski T, Eberhard L, Gallenmüller F, Speck T, Poppinga S. Functional morphology of suction discs and attachment performance of the Mediterranean medicinal leech (*Hirudo verbana* Carena). *J R Soc Interface* 2016;13. <https://doi.org/10.1098/rsif.2016.0096>. <https://doi.org/10.1098/rsif.2016.0096>.
- [39] Sig AK, Guney M, Uskudar Guclu A, Ozmen E. Medicinal leech therapy—an overall perspective. *Integr Med Res* 2017;6:337–43. <https://doi.org/10.1016/j.imr.2017.08.001>.
- [40] Ueno A, Oh-ishi S. Roles for the Kallikrein-Kinin system in inflammatory exudation and pain: lessons from studies on Kininogen-deficient rats. *J Pharmacol Sci* 2003;93:1–20. <https://doi.org/10.1254/jphs.93.1>.
- [41] Al-Bedah AMN, Elsubai IS, Qureshi NA, Aboushanab TS, Ali GIM, El-Olemy AT, et al. The medical perspective of cupping therapy: effects and mechanisms of action. *J Tradit Complement Med* 2019;9:90–7. <https://doi.org/10.1016/j.jtcme.2018.03.003>.
- [42] Moncada S, Palmer RMJ, Higgs EA. Nitric oxide: physiology, pathophysiology, and pharmacology. *Pharmacol Rev* 1991;43:109–42.
- [43] Gw S-S, S T, Jj B. New advances in the understanding of the pathophysiology of chronic venous insufficiency. *Angiology* 2001;52:s27–8.
- [44] Saria A. Substance P in sensory nerve fibres contributes to the development of oedema in the rat hind paw after thermal injury. *Br J Pharmacol* 1984;82:217–22. <https://doi.org/10.1111/j.1476-5381.1984.tb16461.x>.
- [45] Brain SD, Williams TJ. Interactions between the tachykinins and calcitonin gene-related peptide lead to the modulation of oedema formation and blood flow in rat skin. *Br J Pharmacol* 1989;97:77–82. <https://doi.org/10.1111/j.1476-5381.1989.tb11926.x>.
- [46] Chiu IM, Von Hehn CA, Woolf CJ. Neurogenic inflammation and the peripheral nervous system in host defense and immunopathology. *Nat Neurosci* 2012;15:1063–7. <https://doi.org/10.1038/nn.3144>.