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Review Article

SWEDANA AND HEAT SHOCK RESPONSE

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ABSTRACT

Swedana, a revered therapeutic practice in Ayurveda, involves the induction of perspiration within the body. It serves as a crucial component in Ayurvedic treatments, serving as a modality which relieves *Sheeta* (coldness), *Shoola* (pain), *Stambha* (stiffness), *Gaurava* (heaviness), and confers *Mruduta* (softness) to the body. The aim of the study is to explore the action of *Swedana* through the Heat Shock Response (HSR). HSR is a cellular defense mechanism triggered by rise in temperature. *Swedana* therapy and its interplay with the Heat Shock Response is documented, shedding light on the scientific underpinnings of this traditional Ayurvedic practice.

INTRODUCTION

Swedana is a common treatment modality used in Ayurvedic practice where in the body is made to perspire. It is practiced as a *Purva Karma*[1] (prelude to *Panchakarma*), as a stand-alone therapy i.e., *Pradhana* Karma (mentioned in *Shadupakramas*) as well as *Paschat Karma* (post-operative measure in the context of *Shalya Karma* and *Mudhagarbha*)[2]. *Swedana* has its relaxing and detoxifying effects on the body and relieves *Sheeta, Shoola, Stambha* and *Gaurava* as well as provides *Mruduta* to the body[3]. Acharya Charaka mentions, '*Srotaha Su Abhiviliyate*, which signifies the action of *Swedana* over the *Srotas*, by liquifying the *Grahita Dosha*[4]. Proper *Swedana*, when administered following oleation, serves as an indispensable therapeutic technique renowned for its remarkable ability to pacify the aggravated *Prakupita Vata dosha*. This pacification is instrumental in ensuring that *Mala* (waste products), *Mutra* (urine), and *Retas* (semen or reproductive fluids) do not stagnate within the intricate network of the human body.[5] Consequently, *Swedana* emerges as a crucial and highly recommended treatment option not only for *Vataja Vyadhis* but also for *Vata-Kaphaja Vyadhis*.[6]

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This multifaceted application underscores versatility of *Swedana* and therapeutic significance within the holistic framework of Ayurveda, offering hope and healing for a wide spectrum of health conditions.

Swedya Vyadhis

In Ayurvedic classics, the revered Acharyas have extensively documented a multitude of disease conditions for which *Swedana* has been recommended. It underscores the enduring relevance of *Swedana* as a therapeutic modality in Ayurveda, emphasizing its role in promoting health, alleviating diseases, and facilitating the restoration of harmony within the body and mind.

The Acharyas have provided a comprehensive list of various diseases that are indicated for *Swedana* therapy. It consists of neurological ailments such as *Ardita, Ekanga vata, Sarvanga vata, Supthi* etc.[7] Acharya Sushruta incorporated *Bhagandara, Arsha, Ashmari, Aahrita Shalya, Mudhagarbha* which are caused by various types of cell stress[8] and Acharya Vagabhata mentioned *Swedana* as a remedy for *Amaja* conditions.[9]

Mode of Action of *Swedana*

The *Swedana* has major 4 actions

1. ***Stambhaghna*:** *Swedana* alleviates *Stambha*. *Stambha* is caused by *Samana Vayu* and *Sleshaka Kapha*. *Samana Vayu* being *Ruksha Guna Pradhana*, does *Shoshana*. Thus, produces *Sankocha* and *Stambha*. *Sleshaka Kapha* is *Snigdha, Pichila Guna Pradhana*. *Karma Kshaya* of *Sleshaka Kapha*

produces *Stambha*. So, *Snigdha* and *Ushna Guna Yukta Sweda* is beneficial to counter *Stambha*.

2. ***Gauravaghna*:** *Swedana* reduces heaviness in body. Because of *Swedana*, the *Apya Ghatakas* get excreted out of the body through *Sweda*. *Swedana* being *Ushna* in nature does *Kapha Vilayana*, which alleviates the *Guru Guna* and results in lightness of the body.
3. ***Sheetaghna*:** The alleviation of *Sheetata* (coldness or chilliness) within the body can be attributed to the inherent *Ushna Guna* of the *Swedana*.
4. ***Swedakarakta*:** *Swedana* causes perspiration. *Sweda* is a type of *Mala*. This includes not only sweat but also other impurities and toxins that accumulate within the body over time. This dual action of promoting both the expulsion of waste and perspiration underscores the cleansing and detoxifying potential of *Swedana*.

The physiology of sweating, vasodilation have been explored to understand the mode of action of *Swedana* as a treatment modality. One such concept to understand the action of *Swedana* is Heat Shock Response (HSR).

Heat Shock Response

Any cellular stresses which can be caused by a range of conditions, including changes in temperature and mechanical stresses-are damaging to proteins, so cells mount the Heat shock response to counter the stress. The response was discovered on exposure to heat and later it was observed that the response was more prominent on heat stress (i.e., a sudden temperature elevation), hence it was named as Heat Shock Response (HSR).

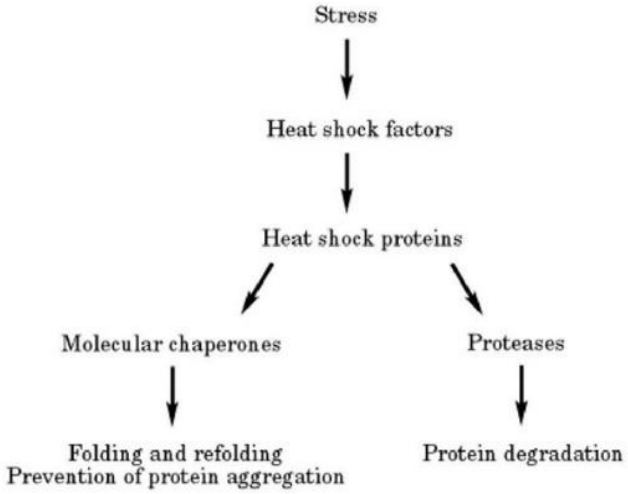
The raise in internal temperature causes a cellular stress resulting in the unfolding of the cellular proteins. The increase in unfolded proteins stimulates the Sigma H factor if the unfolded proteins are present in the cell or Sigma E factor if the unfolded proteins are present outside the cell. This sigma factors upregulate the production of Heat Shock Proteins (HSPs). The HSPs are responsible for countering the unfolding of the proteins by two ways:

1. Acting as a chaperone: If the proteins are misfolded or unfolded, the HSPs act a chaperone which does the refolding of the proteins, thus maintain its functionality.
2. Proteolysis: If the proteins are severely misfolded, the HSPs are responsible for the proteolysis of the protein, to avoid any abnormal function.

Either by chaperones or by proteolysis, the unfolded proteins in the cell reduces. This decrease in unfolded proteins gives feedback to decrease the production of Sigma factors, thus reducing the production of HSPs in the cell.

This mechanism is known as Heat Shock Response.[10] The HSR is summarised in diagram 1.

Diagram 1: Heat Shock Response



DISCUSSION

During *Swedana* therapy, the inherent Ushna, *Teekshna*, and *Sukshma Guna* collectively contribute to a gradual elevation in the general internal body temperature by a few degrees. This rise in temperature serves as the primary stimulus for the induction of perspiration, a natural response aimed at regulating and cooling the body temperature.[11] However, the impact of this temperature elevation goes beyond perspiration, as it also triggers the Heat Shock Response (HSR). In mammals, including humans, the HSR is a sophisticated biological reaction that is typically initiated when the body's temperature surpasses the normal range by approximately 3°C to 5°C[10]. In the context of *Swedana*, the increase in body temperature, although relatively modest, serves as an effective means to activate the HSR. This dual action of inducing perspiration and triggering the HSR underscores the multifaceted benefits of *Swedana* as a therapeutic modality, not only in promoting detoxification through sweat but also in enhancing the body's resilience and self-healing mechanisms to counter the pathologies.

***Swedya Vyadhis* and Heat Shock Response**

Based on the pathology behind the diseases, broadly the *Swedya Vyadhis* mentioned by the Acharyas[7,8,9] can be grouped into 3 categories described below:

1. **Neurological Disorders**: Various diseases mentioned like *Ardita, Pakshaghata, Sarvanga Vata, Ekanga Vata, Khalli, Vepathu, Supti* etc are having neurological pathologies. For instance- *Pakshaghata* is correlated with hemiplegia which results after stroke. Stroke is defined as sudden onsets of neurologic deficit from vascular mechanism 85% are ischemic and 15% are primary hemorrhages.[12]
2. **Disorders Caused By Cell Stress**: Cellular stress disrupts the homeostasis by hampering the cellular

physiology, which in turn may lead to emergence of varied diseases[13]. Various cytotoxic cell stressors are mentioned in Table 2.[14]

Table 2: Cytotoxic Cell Stressors

S.No	Type/Group	Description
1	Mechanical	Compression, shearing, stretching etc.
2	Physical	Heat, cold, radiations
3	Nutritional	Starvation
4	Ph	Alkalosis, acidosis, pH shift
5	Biological	Infection, inflammation
6	Oxygen	Hydrogen peroxide, anaerobiosis to aerobiosis shift (e.g., reperfusion), hypoxia/anoxia (ischemia)
7	Psychological	Emotions, conflicts; hormonal imbalance (HPA axis, autonomic nervous system)

- Conditions caused by Mechanical Cell Stress- Diseases caused by mechanical Stress of Compression, Stretching and Shearing of the tissues includes- *Gridhrasi, Manyastambha, Parshva Graha, Prishtha Graha, Kati Graha, Kukshi Graha, Pada-Janu-Uru-Jangha Graha/Ruk, Aahrita Shalya, Anupdrava Mooda garbha, Ashmari.*
- Condition caused by Physical Cell Stress- *Sheeta*
- Conditions caused by Biological Cell Stress- Diseases caused by infection and inflammation in the tissues- *Pratishaya, Kasa, Shwasa, Karna Shoola, Gala Graha, Swara bheda, Mutraghata, Mutrakrichra, Vriddhi, Kshvathu, Vatakantaka, Hanu Graha, Arsh, Bhagandara.*

3. **Free Radicals:** Ama is considered as free radicals as *Ama* is not a single entity but malformed substances in the body responsible for various diseases.

The concept of *Doshas* is applied to understand the applicability of *Swedana* in the indicated diseases. Mainly *Vataja* and *Vata-Kaphaja Vyadhis* are considered. However, this selective emphasis can give rise to uncertainties and reservations, particularly when considering its suitability for addressing diseases falling under other *Doshic* categories. Questions may arise regarding its appropriateness for conditions rooted in *Pitta* or involving *Rakta Dosha* – for instance *Arshas* (hemorrhoids). This potential mismatch highlights the need for a more comprehensive and inclusive approach to the application of *Swedana*.

Thus, the mode of action of *Swedana* in these categories of diseases can be understood through HSR. The HSR is said to have hormetic effect i.e., exposure to stressor which have beneficial effect on the body.[15]

1. **Misfolding of Proteins**: Protein folding is the process by which polypeptide chains form its 3-d stable structures. This form of the protein is crucial for its functional expression. As this process is sensitive to its environment, misfolding of protein is observed. Protein misfolding is when the polypeptide chain fails to form its proper 3-d structure which leads to misexpression of the proteins.[16] Aggregation of these misfolded proteins is observed to be the pathology behind various other neurological disorders which includes Parkinson's, Huntington's Disease etc. For instance- Alzheimer's disease is one example of neurodegenerative disorder caused by protein misfolding, as the disease is caused by misfolding of secondary beta-sheets of fibrillar beta-amyloid protein present in brain matter.[17] As the pathology lies in the misfolding of proteins, the disease can be countered by HSR by virtue of its refolding. So Swedana, through its ability to induce the Heat Shock Response, may contribute to the restoration of proper protein folding, offering a valuable treatment modality in the holistic management of neurological disorders.
2. **Cross-Tolerance**: Induction of the heat shock response confers protection against other non-thermal cytotoxic stimuli mentioned in Table 1.

For instance,

- *In vitro* experiments have demonstrated that induction of the heat shock response protects endothelial cells against cytotoxic-mediated apoptosis.
- In mammals, the HSR is proposed to promote the production of anti-inflammatory cytokines. The heat shock response has been demonstrated to inhibit a number of genes related to inflammation, including tumour necrosis factor-α, interleukin-1 β, inducible nitric oxide synthase, interleukin-8, RANTES, C3, macrophage chemotactic protein- 1, and intracellular adhesion molecule-1. It inhibits the expression of proinflammatory gene expression thus counters inflammation.[15] Indeed, *Swedana* plays a pivotal role in mitigating the effects of diseases triggered by a wide spectrum of stressors, including

mechanical, biological, and physical stressors on cellular levels. By inducing the Heat Shock Response, *Swedana* not only helps alleviate immediate symptoms but also fosters cellular immunity against the detrimental impacts of mechanical, biological, and physical stressors.

3. **Cytoprotection**: Free radicals are responsible for breaking cell down over a period of time. Mild heat shock exposure in human cell cultures have shown several beneficial effects including improved maintenance of youthful cell morphology, extended replicative life span, increased overall stress tolerance and improved angiogenesis as it decreases the free radicals in body.[18] Thus, *Swedana* alleviates the *Ama* i.e., free radicals from the body. By effectively addressing and eliminating *Ama, Swedana* contributes to the disruption of the *Samprapti* (disease progression) at its very core. This action of *Swedana* targets the root causes of diseases, thereby facilitating the process of *Samprapti Vighatna*- the interruption and mitigation of the disease's natural course.

CONCLUSION

Therefore, it can be reasonably concluded that the *Swedya Vyadhis*, as elucidated by the revered Acharyas, are indeed substantiated by scientific rationale, and their mechanism of action can be comprehensively comprehended through an in-depth exploration of the Heat Shock Response. This understanding not only bridges the gap between traditional Ayurvedic knowledge and modern scientific insights but also highlights the potential synergy between these two paradigms in advancing the understanding of Ayurveda.

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