



## Clinical Research

# Efficacy of *Rasayana Avaleha* as adjuvant to radiotherapy and chemotherapy in reducing adverse effects

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### Abstract

Cancer is the most dreadful disease affecting mankind. The available treatments such as chemotherapy and radiotherapy have cytotoxic effects, which are hazardous to the normal cells of the patient, causing many unnecessary effects. This further leads to complications of the therapy, impaired health, and deterioration of quality of life, resulting in mandatory stoppage of the treatment. In the present study, the efficacy of an Ayurvedic formulation, *Rasayana Avaleha*, has been evaluated as an adjuvant medication to modern radiotherapy and chemotherapy. A total of 36 cancer patients were registered in this trial and were divided into two groups, group A and group B. In group A, the patients were treated with radiotherapy and chemotherapy along with adjuvant *Rasayana Avaleha* (RT + CT + RA), while in group B only radiotherapy and chemotherapy (RT + CT) were given, as the control group. After assessing the results, it was observed that *Rasayana Avaleha* gave better results in controlling the adverse effect of chemotherapy and radiotherapy in comparison with the control group. Therefore, *Rasayana Avaleha* has proved to be an effective adjuvant therapy in protecting patients from the adverse effects of chemotherapy and radiotherapy.

**Key words:** Cancer, Radiotherapy, Chemotherapy, Adverse Effects, Ayurveda, *Rasayana Avaleha*

## Introduction

Cancer has challenged medical scientists with its dreadfulness and adverse effects of available treatments. It has been reported as the second-largest non-communicable disease after ischemic heart disease. Extensive research has produced many new healing methods and hundreds of medications for the management of cancer. Surgical excision is the oldest and most tested therapeutic modality for its treatment. Radiation therapy is effective in controlling a variety of malignant tumors and is a component in the management of about half of all patients with cancer.<sup>[1,2]</sup> Cancer chemotherapy involves the use of cytotoxic drugs and hormones. The clinically useful anti-neoplastic agents are more toxic to the sensitive malignant cells than to the normal cells of the tumor-bearing host. The health-related quality of life is a multidimensional construct that includes the subjective appraisal of the patient's physical, mental, and social

well-being.<sup>[3,4]</sup> Quality of life outcomes are also the key goals of contemporary cancer management.<sup>[5]</sup>

Acute radiation largely affects cell renewal tissues — skin, oropharynx, mucosa, small intestine, rectum, bladder, and vaginal mucosa. These cell renewal tissues are rapidly proliferating. The anorexia–cachexia syndrome is considered by some authorities to be the most common cause of death in patients with cancer.<sup>[6]</sup> Radiation therapy can cause anorexia through multiple mechanisms. Decreased appetite resulting from altered taste and smell is a result of cancer or its treatment, and the psychological factors may result in anorexia, diarrhea, nausea, vomiting, and mucocitis. Cancer cachexia includes metabolic, hormonal, and cytokine-related abnormalities that results in progressive wasting.<sup>[7]</sup> Late effects include necrosis, fibrosis, fistula formation, non-healing ulceration, and damage to specific organs such as spinal cord transaction and blindness.<sup>[8]</sup>

In cancer patients treated annually with chemotherapy, possibly 20% are cured and an additional 20% may experience significant prolongation of life. The remaining 60% have minimal or no benefit from cytostatic treatment and suffer from its toxic adverse reactions.<sup>[9]</sup> Nausea and vomiting are immediately apparent after commencing chemotherapy. Therefore, these two have been identified as the toxicities of chemotherapy most

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feared by the patient.<sup>[10]</sup> Rapidly dividing cells found in the bone marrow, mouth, stomach, intestines, and hair follicles bear the brunt of the damage. Sores in the mouth and mucocitis are also common adverse effects of chemotherapy.

In modern medical history and Ayurveda, a number of references are available regarding the pathogenesis and management of cancer. In Ayurveda, all cancerous growths have been described under various types of *Arbuda*. Malignancies can be considered under various *Tridoshika* and *Asadhya* (incurable) presentations of the disease. Surgery has been conducted for the treatment of unwanted growth. After surgery, and along with surgery, radiotherapy and chemotherapy are the other treatment modalities for destroying the cancerous cells and providing amelioration to the patients. Radiotherapy and chemotherapy may also prevent the metastasis and regeneration of cancerous tissues in operated patients. Radiotherapy is a treatment modality vastly implied on the patients. Usually, <sup>60</sup>Co, <sup>137</sup>CS, and <sup>120</sup>I are used. The efficacy of the radiotherapy has been described by 4 'R's, that is, repair, redistribution, repopulation, and reoxygenation. The controlled use of radiotherapy provides different outputs on healthy and malignant tissues. It has been found that selectively malignant cells are damaged because they are found to be most sensitive to the ionizing radiation in the same phases of the cell cycle. The biological efficacy of radiation depends on factors like radiation quality, dose per fraction, dose rate, presence or absence of oxygen, and cell type involved even after all the precaution and control events. Radiotherapy frequently causes damage to the normal cells, which is evident in the form of adverse reactions. These adverse effects have been grouped under three classes on the basis of the result. In severe cases, due to overexposure, severe morbidity or death may result. Class II radiation may cause degradation of the quality of life. Class III radiation may cause mild, transient, and reversible reactions. After radiotherapy, acute adverse reactions like nausea, vomiting, skin reaction, mucocitis, and fatigue occur. Among the chronic long-term effects, xerostomia, tastelessness, edema, and damage to other organs may occur.

In the last few years, after vigorous researches regarding safety, the efficacy profiles of radiotherapy and chemotherapy have improved significantly. However, these therapies still produce severe undesired adverse effects. These adverse effects force the patients to discontinue the treatment and make their life miserable and pitiful.

Therefore, in the present study, an attempt has been made to counteract these sufferings through Ayurvedic treatment. *Rasayana*, that is, rejuvenation therapy, is a unique contribution of Ayurveda that provides multidimensional benefits. Therefore, much attention is being directed to harness and harvest the *Rasayana* therapy, with its *Vayahsthapana* (anti-aging), *Balya* (restoring power), *Jeevaniya* (improving vitality), and other properties, to nourish all *Dhatu*s (tissue elements) properly and restore the basic homeostatic balance. In view of reducing the dangerous adverse effects of chemotherapy, the present study was planned by selecting *Rasayana Avaleha* — an Ayurvedic preparation — as adjuvant to allopathic chemotherapy. The herbal preparation comprises of *Amalaki* (*Emblica officinalis*), *Ashwagandha* (*Withania somnifera*), *Guduchi* (*Tinospora cordifolia*), *Yashtimadhu* (*Glycyrrhiza glabra*), *Jivanti* (*Leptadenia reticulata*), *Tulasi* (*Ocimum sanctum*), and *Pippali* (*Piper longum*). All these herbs have been extensively researched for their various rejuvenative properties at the clinical and experimental levels.

Therefore, all these drugs have been selected as the ingredients for *Rasayana Avaleha*. The aim of the *Rasayana* therapy as an adjuvant therapy, in this study, is not only to add years in the life, but also to add life in the years, whatever the patients have left.

## Materials and Methods

### Patients

Thirty-six patients fulfilling the diagnostic criteria of carcinoma (under treatment of radiotherapy and chemotherapy) were randomly selected from the OPD and IPD of the Oncology Department of the G.G. Hospital, and registered at the OPD of the Institute for Post Graduate Teaching and Research in Ayurveda Hospital, Gujarat Ayurved University, Jamnagar, in the present study.

### Ethical clearance

The Institutional Ethical Committee of the IPGT and RA Hospital, Gujarat Ayurved University, Jamnagar, approved the study. An informed written consent was taken from each patient willing to participate before the commencement of the trial. The patients were free to withdraw their name from the study at any time without giving any reason.

### Inclusion criteria

1. Diagnosed cases of carcinoma at stage T<sub>1</sub> or T<sub>2</sub> being submitted for radiotherapy or chemotherapy or both.
2. Those complaining of acute short-term adverse effects.
3. Those between the age group of 16 and 70 years.

### Exclusion criteria

1. Patients in the T<sub>4</sub>M<sub>2</sub> stage and having chronic long-term local adverse effects were excluded from the study.

### Drug

*Rasayana Avaleha* was prepared as per the Ayurvedic classical method of preparing *Chyavanprash*, in the Pharmacy of Gujarat Ayurved University, Jamnagar. The proportion of the ingredients was as follows: *Amalaki* (one part), *Ashwagandha* (one-fourth part), *Guduchi* (one-fourth part), *Yashtimadhu* (one-fourth part), *Pippali* (one-tenth part), *Tulasi* (one-tenth part), sugar (one part), and ghee (quantity sufficient). The preparation was formulated in the *Avaleha* form, which is a semi-solid pharmaceutical preparation, termed as 'electuary'. For authentication and standardization of the prepared drug, the phytochemical evaluation of *Rasayana Avaleha* had been carried out by Thin Layer Chromatography and High Performance Thin Layer Chromatography densitometry analysis, including fingerprint profiling, as well as quantification of marker / biomarker compounds. The TLC fingerprinting profile had revealed the presence of all the claimed plant ingredients and provided substantial support to authenticate the formulation. The different ingredients of the formulation contained important marker compounds, namely, piperine, B-sitosterol, eugenol, and lupeol. These compounds are biomarkers because they have been seen to have several biological activities. Suitable extraction procedures were adapted to ensure complete extraction of the compounds from the samples. The presence of the markers in the sample extract was ascertained by cochromatography and comparison of the R<sub>f</sub> and relative percentage with that of the standards of the marker compounds.

**Dose**

The dosage was 30 g early in the morning with 10 ml of ghee.

**Duration**

Seventy-five days.

**Grouping**

The patients were divided into two groups using a random sampling method.

In the first group, group A, *Rasayana Avaleha* was given via the oral route along with radiotherapy and chemotherapy. In this group, a total of 23 patients was given radiotherapy, 1.8 – 2 gray / day, five fraction / week, total 60 – 70 gray. In chemotherapy, the chemotherapeutic agents and their dose and duration varied according to the type of cancer and the patient’s physical condition. Of the 23 patients, 16 completed the treatment. In

the second group, group B, only radiotherapy and chemotherapy (RT + CT), as mentioned earlier, were given without *Rasayana Avaleha*. In this group, a total of 13 patients were treated, of which nine patients completed the course of therapy.

**Assessment criteria**

Assessment of the effect of therapy was carried out on the basis of the improvement and occurrence of known adverse effects, as per the guidelines for grading adverse effects by the National Cancer Institute, Oncology group,<sup>[11]</sup> as shown in Tables 1 and 2.

The data were then subjected to statistical analysis in terms of mean, standard deviation, and standard error. The paired “t”-test was applied and the level of significance was noted at  $P < 0.05$ ,  $P < 0.01$ , and  $P < 0.001$ . The overall assessment of the effect of therapy was made on the basis of the following criteria:

**Table 1: Assessment of chief symptoms**

Symptoms	Criteria for assessment	Grade
Nausea and vomiting	None	0
	Able to eat and one episode in 24 hours	1
	Oral intake significantly decreased, two to five episodes in 24 hours	2
	No significant intake, requiring IV fluids, > 6 episodes in 24 hours	3
Mucocitis	None	0
	Erythema of the mucosa	1
	Patch pseudomembranous reaction	2
	Confluent pseudomembranous reaction	3
Fatigue	Necrosis of deep ulceration may include bleeding not induced by minor abrasion	4
	None	0
	Increased fatigue over baseline, but not altering normal activities	1
	Moderate or difficulty performing some activities	2
	Severe or loss of ability to perform some activity	3
	Bedridden or disabling	4

**Table 2: Assessment of associated symptoms**

Associated symptoms	Criteria for assessment	Grade
Alopecia	Normal	0
	Mild hair loss	1
	Moderate	2
Xerostomia	None	0
	Slightly thickened saliva, may have slightly altered taste	1
	Thick, ropy, sticky saliva, markedly altered taste, alteration in diet required	2
	Moderate alteration in saliva	3
Tastelessness	Acute salivary gland necrosis	4
	Normal	0
	Slightly altered	1
Skin reaction	Markedly altered	2
	None	0
	Faint erythema or dry desquamation	1
	Moderate to brisk erythema or patchy, moist desquamation, mostly confined to skin folds and creases, moderate edema	2
	Confluent moist desquamation > 1.5 cm diameter and not confined to skin folds; pitting edema	3
	Skin necrosis or ulceration of full-thickness dermis, may include bleeding not included by minor trauma or abrasion	4

Complete remission: 100% relief.  
 Marked improvement: > 75% relief.  
 Moderate improvement: > 50% to 75% relief.  
 Mild improvement: 25 – 50% relief.  
 Unchanged: < 25% or no relief.

## Observations

### Age - Gender - Religion

A maximum of 33.33% of the patients were in the age group of 50 – 60 years and 30.30% were in the 40 – 50 years age group. Thus, a maximum in the 50 years onward age group was predominantly affected. This age is considered as older and it seems that the occurrence of cancer progresses as age increases. A maximum of 68.18% of the patients were male, which correlates with the general observation. The maximum number of patients (83.33%) was of Hindu religion, which may be due to the predominance of the Hindu population in Jamnagar and its periphery. No conclusion can be elicited in this context, as that geographical zone had a majority of that particular religion.

### Education and occupation

The maximum number of patients (45.45%) was illiterate. Lack of proper education renders one incapable of coping with their disease condition. A maximum of 24.56% were from the daily laborer class. Insufficient dietary nourishment and irregular food habits had to be an important causative factor in cachexia and could hamper the immune system, leading to disequilibrium in normal cells, which was further vitiated by radiotherapy and chemotherapy.

### Dietetics and lifestyle

Most of the patients were taking a mixed type of diet (53.03%). A maximum of 34.84% of the patients had *Vishmagani*, followed by 14.69%, who had *Tikshnagni*. A maximum of 68.18% of the patients followed *Adhyashana* (eating again and again) as a dietary habit. All these observations showed the altered dietary conditions in cancer patients. In these patients, the calorie expenditure often remained high and the basal metabolic rate was increased despite reduced food intake. By contrast, in starvation, there was an adaptation; lowering of metabolic rate.<sup>[12]</sup>

### Body constitution and bowel habit

Unsatisfactory bowel clearance was found in 54.54% of the patients, among which 45.58% of the patients had constipated bowel, while 8.82% of the patients had loose motion. In the present study, 45.58% of the patients had *Vata Kapha Prakriti*. This observation emphasizes that cancer (which is described as *Arbuda* in Ayurvedic texts) is also *Vata Kapha Dosha* dominant, and *Vata Kapha Prakriti* persons are probably more prone to cancer.

### Addiction

A maximum of 57.57% of the patients had an addiction of smoking, followed by pan malasa and smoking, and only pan masala in 37.87 and 12.12% of the patients, respectively; 42.42% of the patients had an addiction of alcohol, whereas, 34.84% of the patients consumed excessive soda, which are known to be major causative factors to enhance the carcinogenesis process. Each puff of smoke contains about 2,000 – 4,000 compounds, many of which, such as arsenic, formaldehyde, insecticides, nitrosamines, and polonium 210, are proven cancer causers. Armed with these carcinogens, smoke can damage any body part in its path.<sup>[13]</sup> Many

scientists have found a similar link between alcohol, smoking, and cancer of the mouth, throat, and esophagus. A study on moderate smokers estimated that those who are also heavy drinkers are 25-times more likely to get esophageal cancer.<sup>[14]</sup>

### Dietetics and working capacity

A maximum of 52.03% of the patients had anorexia. This anorexia was probably due to excessive secretion of the tumor necrosis factor (TNF) in cancer cases, leading to inhibition of the appetite center, and a rise in anorexia, which also led to inhibition of the appetite. A maximum of 62.11% of the patients had medium digestion power. Working capacity was medium in 57.57% and very poor in 34.84%.

The assessment purpose before the treatment score, was recorded after 15 days of starting the therapy. According to the same observation, the chief complaints (adverse effect) were as follows: fatigue was found in 83.33% of the patients, nausea and vomiting were found in 78.78% of the patients, mucocitis was found in 71.21% of the patients, and 33.33% of the patients had alopecia.

### Associated complaints

Maximum patients, that is, 43.93%, were suffering from xerostomia, 36% had excessive salivation, and 27% patients reported that they did not have any taste.

## Results

### Efficacy of *Rasayana Avaleha* (RT + CT + RA)

*Rasayana Avaleha* showed significant results on nausea and vomiting (86%), mucocitis (72.14%), and fatigue (58.93%). Also, other symptoms like xerostomia (48.17%), alopecia (45.24%), and tastelessness (33.59%) were decreased [Table 3].

On treatment with radiotherapy and chemotherapy, the symptoms like mucocitis, xerostomia, and tastelessness were increased by 21.42, 27.27, and 50%, respectively, whereas, other symptoms like nausea and vomiting, fatigue and alopecia were found to have decreased after 75 days [Table 4].

In both groups, weight loss was observed in the treated patients, but the weight loss was lower in patients treated with *Rasayana Avaleha* as compared with the RT and CT group [Table 5].

In the RT + CT group, the condition of 22.22% of the patients worsened, while that of the same number of patients was unchanged, however, 55.55% of the patients showed mild improvement. In the treated group of RT + CT with *Rasayana Avaleha*, a total of 56.25% of the patients showed moderate improvement and 43.75% were markedly improved in their symptoms. In this group, the conditions did not worsen or remain unchanged in any patient in contrast to the other group [Table 6].

## Discussion

The treatment modality 'Radiotherapy' is a type of *Tejas Mahabhuta Chikitsa*, which can be considered as modified radiations of *Agni Karma* according to Ayurveda. The *Ushna*, *Tikshna*, and *Ruksha Guna* of *Agni Mahabhuta* perform the functions listed against radiotherapy. These properties cause the vitiation of *Pitta*, *Vata*, and *Rakta*, which may be local and generalized. Because of the increase in the *Ruksha*, *Ushna*, and

**Table 3: Effect of therapy in the RT + CT + RA group**

Symptoms	Mean		Mean	%change	SE (±)	P
	BT	AT				
Nausea and vomiting	1.5	0.21	1.29	86↓	0.21	< 0.001
Mucocitis	1.4	0.39	1.01	72.14↓	0.25	< 0.05
Fatigue	2.07	0.85	1.22	58.93↓	0.13	< 0.001
Xerostomia	1.64	0.85	0.79	48.17↓	0.25	< 0.05
Alopecia	2.21	1.21	1.0	45.24↓	0.27	< 0.1
Tastelessness	1.28	0.85	0.43	33.59↓	0.21	< 0.05

↓, decrease; BT - Mean Before treatment score, AT - Mean after treatment score, SE - Standard error

**Table 4: Effect of therapy on RT + CT (control group)**

Symptoms	Mean		Mean	%change	SE (±)	P
	BT	AT				
Nausea and vomiting	2.5	1.8	0.7	28↓	0.15	< 0.01
Mucocitis	1.4	1.7	-0.3	21.42↑	0.37	< 0.05
Fatigue	2.4	2.2	0.2	8.33↓	0.27	< 0.05
Xerostomia	1.1	1.4	-0.3	27.27↑	0.27	< 0.01
Alopecia	2	1.5	0.5	25↓	0.31	< 0.01
Tastelessness	1.2	1.8	-0.6	50↑	0.30	< 0.001

↓, decrease; ↑, increase

**Table 5: Effect of therapy on weight**

Group	0	5%	10%	20%	Average (%)
RT + CT	-	44.44	44.44	11.11	11
RT + CT + RA	7.14	57.14	21.42	14.28	7.7

**Table 6: Total effect of the therapy on radiotherapy + chemotherapy - control group**

Effect	RT and CT group		RT + CT + RA group	
	No. of patients	Percentage	No. of patients	Percentage
Worsened	2	22.22	0	0
Unchanged	2	22.22	0	0
Mild improvement	5	55.55	0	0
Moderate improvement	0	0	9	56.25
Marked improvement	0	0	7	43.75
Complete remission	0	0	0	0
Total	9	100	16	100

Tikshna properties, the Kapha decreases leading to Oja Kshaya. This also leads to Dhatupaka (vitiation of tissue elements). Thus, the patient taking this treatment loses his own Bala to protect himself against the adverse effects of radiotherapy.

Various types of chemotherapeutic drugs are used for the management of cancer. According to a study, in cancer patients treated with chemotherapy, 20% may be cured, and 20% may experience significant prolongation of life, while the remaining 60% may have minimal or no benefit from cytostatic treatment and suffer from its toxic and adverse reactions. Chemotherapeutic agents can be considered as Visha Dravya (toxins) as per Ayurveda. These agents are Ushna Veerya (hot potency), Tikshna Dravyas working as a two-edged sword, and while destroying cancerous cell also destroy healthy normal fast-growing cells of the gastrointestinal tract, mucous membrane, skin, hair root, and so on. Hence, the medicotherapeutics of chemotherapy can be explained on the basis of Visha. The

chemotherapeutic agents seem to possess properties like Ruksha, Ushna, Tikshna, Sukshma, Ashukari, Vyavayi, Vikasi, Vishada, Laghu, and the like. Most of these properties are opposite to the Rasa, Kapha, and Ojas and similar to the Rakta, Pitta, and Vata; hence, chemotherapeutic agents may also cause Vata, Pitta, Vriddhi (vitiation of Vata and Pitta) and Kapha Kshaya (depletion of Kapha) along with Rasa Rakta Kshaya (depletion), leading to Oja kshaya.

In Ayurveda, the management of Agnidagdha (burn), Dhatupaka (vitiation), and Visha Chikitsa (toxin treatment) is described with scattered references. The patients can be protected from the adverse effects of radiotherapy and chemotherapy by using Vata Pitta Shamaka, Kapha Ojas Vardhaka, and Rasa Rakta Prasadaka herbs. Most of the Rasayana drugs, especially those that are Balya, Brimhana, Shramahara and Jeevaniya, will be useful in the management of these conditions. Most of the drugs selected as ingredients of Rasayana Avaleha are proved



under the *Rasayana*, and ghee is also an important drug used as *Agada* (anti-toxic) and in *Dagdha Chikitsa* (anti-burn).

On the basis of the above *Doshika* configuration, the *Samprapti* (pathophysiology) of the *Lakshanas* (symptoms) appearing as adverse effects of radiotherapy and chemotherapy can be explained properly by the explanation of the *Samprapti* of these *Lakshanas*. The classical *Samprapti* of *Chhardi*, *Arochaka*, *Kushtha*, *Trishna*, and *Shosha* can be used, and these become very useful while framing the treatment modalities of these conditions. All over the world, experimental studies are being carried out regarding the adjuvant / protective effect of various Ayurvedic herbs in cases of radiotherapy and chemotherapy. On the basis of the classical probing of the adverse effects of RT + CT and the research reports available, herbs like *Amalaki* (*Emblca officinalis*), *Ashwagandha* (*Withania somnifera*), *Guduchi* (*Tinospora cordifolia*), *Yashtimadhu* (*Glycyrrhiza glabra*), *Jivanti* (*Leptadenia reticulata*), *Tulasi* (*Ocimum sanctum*), and *Pippali* (*Piper longum*) have been selected for the present study.

The fruits of *Emblca officinalis* have antioxidant and antiemetic properties. The efficacy of *Emblca officinalis* in relieving the dyspeptic symptoms as well as in promoting the healing of ulcers is well known.<sup>[15]</sup> The anabolic activity reported in *Amalaki* (*Emblca officinalis*) increases the positive nitrogen balance, and the total protein level leads to an increase in body weight.<sup>[16]</sup> *Ashwagandha* (*Withania somnifera*) exhibits adaptogenic, immune stimulation activity and an anti-mutagenic effect, suggesting a high potential of this plant in cancer management.<sup>[17,18]</sup>

Sodium glycyrrhizate present in *Yashtimadhu* possesses an anti-ulcer activity and stimulates the regeneration of skin (USSR 1991). *Yashtimadhu* contains carbenaxolone derived from glycyrrhizic acid, and it is reported that carbenaxolone can increase mucous production, which can inhibit vagus irritation in the gastrointestinal tract and accelerate the antiemetic effect. Psychogenic stress causes vagal stimulation, leading to nausea and vomiting. The anti-cholinergic effect of *Yashtimadhu* reduces gastric irritation. The hydro-alcoholic extract, as *Ocimum sanctum*, provides a radioprotective effect when given intraperitoneally before a whole-body exposure to 11 gray of Co-60,<sup>[19]</sup> exhibiting a chemoprotective effect.<sup>[20]</sup> *Pippali* has *Katu Rasa* (pungent taste). This can induce a mild irritation to the tongue, giving a tactile stimulation to the inferior salivary nuclei at the juncture of the medulla and the pons. This enhances salivary secretion (serous). *Pippali* contains the alkaloids piperine and piperidine and two new alkaloids, one of them designated as alkaloid A. This is closely related to piperidine, producing marked salivation in the mucous membrane of the mouth (Atal and Ojha, 1965). These properties are helpful in contracting xerostomia. *Jivanti* has *Madhura Rasa*, *Shita Veerya*, *Madhura Vipaka*, and *Vatapitta Shamaka*, categorized in *Rasayana* drugs. This leads to *Sarva Dhatusara* and *Oja Pradurbhava*. Here, *Oja* is considered to enhance *Pratyaneek Bala*, and promotes the healing process and tissue building.

*Ghrita* (ghee) has *Madhura Rasa* (sweet taste), *Sheet Veerya* (potency), *Vatapitta Shamaka*, and *Kapha Vardhaka* properties and *Vayah Sthapana* and *Vishahara* actions. All these play a major role in re-establishing homeostatic balance and restoring the physiological process (*Dhatuvyapar*).<sup>[21]</sup> Essential fatty acids present in the *Ghrita*-carrying medicament penetrate in any normal cell. After that, beta-oxidation occurs and the

medicament is released to the target tissue. Their major role is also established as precursors of prostaglandin. As far as *Brimhanam*<sup>[22]</sup> and *Poorana* are concerned, except *Tulasi* (*Ocimum sanctum*), all the ingredients of *Rasayana Avaleha* have *Jeevaniya*, *Vayahsthana*, *Balya*, and *Brimhaniya* properties, which help to restore the physical strength and support the normal cellular resistance to protect them as well as repair them.

Most of the drugs in this formulation had *Madhura Rasa*, *Sheeta Veerya*, and *Madhura Vipaka*. After reviewing the cumulative properties of *Rasayana Avaleha*, it is observed that it has *Madhura Rasa*, *Snigdha* property, *Madhura Vipaka*, *Sheeta* potency, and *Vata-Pitta shamaka doshghnata*. All these are helpful in nourishing the depleted *Kapha Dosh*, contributing to increased weight of body and filling of the cellular substance by more *Dhatu Poshaka Dravya*, that is, *Poorana Karma*, through the action of *Dhatwagni*. The biological function of *Kapha* promotes the healing process and tissue building. These also pacify the vitiated *Vata-Pitta Dosh*, which plays a major role in the occurrence of adverse effects.

These results indicate the effect of *Rasayana Avaleha* to counteract the cancer anorexia-cachexia syndrome, the main cause of malnutrition in cancer patients. The nutritional status of the patients can have an important impact on the efficacy of the cancer treatment. Malnourished patients are at risk of infections because of immune suppression. They may have impaired wound healing after surgery and malnutrition may exacerbate the side-effects of chemotherapy and radiation therapy. The cancer anorexia-cachexia syndrome is also considered as the most common cause of death in patients with cancer.

Beta-carotene and triptolene have a nootropic activity, which is present in *Yashtimadhu*, and works on immunological depression, to inhibit the excess secretion of catecholamine and cortisone. This result shows marked-to-moderate improvement in the psychological status of the patient. The mind communicates with the immune system, and this communication is done via the endocrine system in the following link:

Mind-immune system link with nerve fibers interlaced between T cells, lymphocytes, and macrophages →→ ganglia (nerve bundles) →→ spinal cord →→ brain →→ from nerve pathway sympathetic / parasympathetic nervous system →→ through neurotransmitters noradrenaline →→ bind to immune cell reception →→ modulate the immune system.

### Action on cytokinase

*Rasayana Avaleha* counteracts the various adverse effects of RT and CT, in particular as under: *Tulasi*, which has *Vishanashana prabhava*, and probably destroys the toxic substances released by cell injury when administered with radiotherapy and chemotherapy. The radioprotective effect of the extract of *Tulasi* leaves has also been proved by pharmacological study.

### Action as adaptogen and antioxidant

*Guduchi*, *Ashwagandha*, and *Jivanti* are reported as having adaptogenic activity. An adaptogen exerts its effect on both sick and healthy individuals by correcting any dysfunctions without producing unwanted side-effects. Flavonoids as potent antioxidants are present in *Guduchi*, *Ashwagandha*, *Amalaki*, *Pippali*, and *Tulasi*. These are especially important for protection against human disease. The electron and H-donating capacity

of flavonoids seem to contribute to the termination of the lipid peroxidation chain reaction, which is released due to the excessive secretion of TNF, interleukin-1, and also chemotherapeutic cytotoxic agents. Flavonoids are essential for protection against H<sub>2</sub>O<sub>2</sub>-mediated cytotoxicity, which is created by radiotherapy.

The above-mentioned data are sufficient to prove that when *Rasayana Avaleha* is added as an adjuvant therapy, it provides marked and statistically significant relief in almost all the patients. However, looking at the specific nature of this treatment, where radiotherapy and chemotherapy work as *Nidana* for symptomatology, these cannot be discontinued as *Nidana Parivarjana*, as recommended in the classics. Hence, wherever possible, *Rasayana Avaleha* should be started at least 10 days before commencing the radiotherapy and chemotherapy schedule and should be continued for three months after its completion. Thus, *Rasayana Avaleha* proves its efficacy in reducing the adverse effects of radiotherapy and chemotherapy and in enhancing the quality of life of the patient.

## Conclusion

From the present study, it can be concluded that *Rasayana Avaleha* gives better results in controlling the adverse effect of chemotherapy and radiotherapy in comparison with the control group. Therefore, administration of *Rasayana Avaleha* along with chemotherapy and radiotherapy can improve the quality of life of cancer patients. Although the sample size studied is small, the research emerges as a ray of hope toward the successful integrated treatment of an allopathic modality along with Ayurvedic medicine as an adjuvant. This therapy certainly improves the quality of life of the patient and may enhance the life expectancy. In a nutshell, *Rasayana Avaleha* is an effective adjuvant therapy in protecting the patient from the adverse effect of chemotherapy and radiotherapy.

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