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Original article

Exploratory studies on the therapeutic effects of *Kumarabharana Rasa* in the management of chronic tonsillitis among children at a tertiary care hospital of KarnatakaG.R. Arun Raj^a, U. Shailaja^a, Parikshit Debnath^{b,*}, Subhadip Banerjee^c, Prasanna N. Rao^d^a Department of Kaumarabhritya, SDM College of Ayurveda and Hospital, Hassan, Karnataka, India^b Department of Swasthavritta, SDM College of Ayurveda and Hospital, Hassan, Karnataka, India^c Department of Pharmacology, Bengal Institute of Pharmaceutical Sciences, Kalyani, West Bengal, India^d Department of Shalyatantra, SDM College of Ayurveda and Hospital, Hassan, Karnataka, India

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ABSTRACT

The effect of an Ayurvedic poly-herbo-mineral formulation *Kumarabharana Rasa* (KR) in the management of chronic tonsillitis (*Tundikeri*) in children has been assessed in this study. This clinical study was a double-arm study with a pre- and post-test design at the outpatient level in a tertiary Ayurveda hospital attached to a teaching institute located in district headquarters in Southern India. Patients ($n = 40$) with chronic tonsillitis satisfying diagnostic criteria and aged between 5 and 10 years were selected from the outpatient Department of Kaumarabhritya, SDM College of Ayurveda and Hospital, Hassan. Among them, 20 patients were treated with *Kumarabharana rasa* (tablet form) at a dose of 500 mg once daily for 30 days (Group A). The other 20 patients were treated with *Godhuma Vati* (placebo) at a dose of 500 mg once daily for 30 days (Group B). In both groups, *Madhu* was the *Anupana* advised. After completion of 30 days of treatment, the patients were assessed on the following day and another investigation took place 15 days later. Statistically significant effects ($p < 0.05$) in the reduction of all signs and symptoms of chronic tonsillitis after KR treatment were observed. These results indicate that *Kumarabharana Rasa* has an ameliorative effect in reducing the signs and symptoms of chronic tonsillitis.

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1. Introduction

Chronic tonsillitis (CHT) is one of the most common otolaryngologic diseases.¹ CHT is rare in infants and older people. In young children, tonsillitis is one of the recurrent upper respiratory tract infections. CHT is a highly prevalent disease in the pediatric age group, and it peaks between 3 and 10 years of age and then declines.^{2,3} In general practice children frequently visit with recurrent throat problems⁴ and the incidence of this disease accounts for about 7% of all visits to the pediatrician.³ Children with CHT experience discomfort, and the disease also impacts on social,

emotional, and financial aspects for family members.⁵ Tonsillitis is an infection of the tonsils.^{6–8} Despite its high prevalence, the etiology of CHT has remained indistinct. The surface and deep bacterial flora of chronic inflamed tonsils consist of an abundance of probable pathogenic aerobic and anaerobic bacteria, primarily of streptococcal origin.^{9–13} Tonsils are part of the immune system. Therefore, due to the decrease in immunity and the tonsils' incompetence in helping the immune system, they actually become a source of recurrent infections.³ The current treatment option for CHT is tonsillectomy, but it is not the ultimate solution. The generally accepted criteria for tonsillectomy are at least three to seven episodes of tonsillitis per year in spite of medical therapy, but there is no international consensus.¹⁴

In Ayurvedic thought, tonsillitis can be correlated to *Tundikeri*, which is one of the *Urdhvajatrugata Roga* (diseases of the head and neck); it is mentioned in *Talugata Roga*¹⁵ (diseases of the palate) as well as *Kanthagata Roga* (diseases of the throat).¹⁶ Ayurveda explains that it is caused by the vitiation and imbalance of *Doshas*

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(bodily humors), i.e., *Vata*, *Pitta*, and *Kapha*. Mainly derangement of *Kapha* and *Rakta* (blood) is preceded by impaired digestive capacity (*Mandagni/Vishamagni*) and obstruction of channels (*Srota Avarodha*) namely *Annavaha Srotas* (gastrointestinal tract) and *Pranavaha Srotas* (respiratory tract) which is manifested as difficulty in swallowing, mouth breathing, choking spells at night, etc.^{15,16} The present study was conducted to explore the efficacy of *Kumarabharana Rasa* (KR) in the management of chronic tonsillitis in children. KR has a combined action over vitiated *Doshas* due to its anti-inflammatory, antimicrobial, immunomodulatory, and rejuvenative effects.

2. Materials and methods

2.1. Design

This study was an open-labeled double-arm setting with a pre- and post-test design.

2.2. Participants

Children presenting with any of the symptoms of chronic tonsillitis (*Tundikeri*), i.e., *Kathina Shotha* (enlargement of tonsils), *Ragatwa* (hyperemia), *Galoparodha* (dysphagia), *Mukha Daurgandhya* (halitosis), *Lasikagranthi Vriddhi* (enlargement of lymph nodes), and *Jwara* (fever) were selected and registered from *Kaumarabhritya* (Ayurvedic Pediatrics) outpatient department of SDM College of Ayurveda and Hospital, Hassan between June 2012 and December 2013. Before initiating the study ethical clearance was obtained from institutional ethics committee of SDM College of Ayurveda and Hospital, Hassan (IEC No. SDMAH/IEC/57/11-12 dated 01-04-2012). Written informed consent was taken from the parents of the study participants before any study-related procedures were performed. Inclusion criteria were: children of both sexes between 5 and 10 years of age and who had repeated attacks of tonsillitis (chronic infections) in the past year. Exclusion criteria were: patients with acute tonsillitis, peritonsillar abscess, tonsillar cyst, tonsillolith, or any other systemic disorders; patients who had taken systemic steroids and/or antibiotics in the past 4 weeks.

2.3. Study drugs

2.3.1. Kumarabharana Rasa

This is a compound drug comprising *Bhasmas* (purified calx) of *Swarna* (gold), *Rajata* (silver), *Pravala* (coral) and *Churna* (powder) of *Yastimadhu* (*Glycyrrhiza glabra* Linn.), *Amlaki* (*Emblica officinalis* Gaertn.), *Ashwagandha* (*Withania somnifera* Dunal.), *Sunthi* (*Zingiber officinale* Rosc.), *Pippali* (*Piper longum* Linn.), *Haritaki* (*Terminalia chebula* Retz.), *Vacha* (*Acorus calamus* Linn.). All these drugs were processed with *Swarasa* (extract juice) of *Guduchi* (*Tinospora cordifolia* Miers ex Hook. F. & Thoms), *Brahmi* (*Centella asiatica* Linn.), and *Tulsi* (*Ocimum tenuiflorum* Linn.) separately then prepared in tablet form.¹⁷

2.3.2. Godhuma Vati (placebo)

Wheat powder was processed and prepared in tablet form.

Raw drugs were obtained from SDM Pharmacy, Udipi and authenticated in the Department of Dravyaguna, SDM College of Ayurveda and Hospital, Hassan. The medicine was prepared in the Teaching Pharmacy, SDM College of Ayurveda and Hospital, Hassan. Tablets of 500 mg were prepared and preserved in airtight, properly labeled plastic bottles containing 30 tablets in each.

2.4. Intervention

A total of 53 patients were screened for chronic tonsillitis. Among them 40 patients were enrolled into the study fulfilling the inclusion and exclusion criteria. A convenient sampling technique was adopted, with 20 patients each in study group (KR) and the control group (*Godhuma Vati*). The patients in the study group were treated with KR (tablet form) at a dose of 500 mg once daily for 30 days. The patients in the control group were treated with *Godhuma Vati* (tablet form) at a dose of 500 mg once daily for 30 days. Parents were advised to crush the tablet to a powder and to give it to the child using honey as *Anupana* (vehicle for drug administration) before food, in the morning, for both groups.

2.5. Observation-based assessment criteria

2.5.1. Subjective parameters

The assessment of the signs and symptoms were done on the Day 0 and Day 31. Severity was assessed by grading 1–5 (absence to severe) for each symptom. *Kathina Shotha* (enlargement of tonsils) – no enlargement, enlarged within anterior pillars, enlarged within posterior pillars, enlarged beyond pillars, kissing tonsils with sleep apnea. *Ragatwa* (hyperemia) – no hyperemia, hyperemia of tonsil surface, pinkish appearance of pillars, reddish appearance of surroundings, reddish appearance of surroundings and pharynx. *Galoparodha* (dysphagia) – no pain while swallowing, pain during swallowing solid food substances, pain during swallowing semi-solid food substances, pain during swallowing liquid food substances, continuous pain/unable to swallow. *Mukha Daurgandhya* (halitosis) – no halitosis, foul breath experienced by the patient only, foul breath experienced by the patient and friends/parents, foul breath is experienced by a group of surrounding people, foul breath is experienced as soon as the patient opens the mouth. *Lasikagranthi Vriddhi* (enlargement of lymph nodes) – no palpable lymph nodes, palpable lymph nodes unilateral/warm, palpable lymph nodes bilateral/soft/fluctuant, palpable lymph nodes bilateral which are hard, palpable lymph nodes bilateral with tenderness. *Jwara* (fever) was measured according in degrees Fahrenheit (normal was 98.6° Fahrenheit).

2.5.2. Objective parameters

Assessments were based on routine laboratory blood investigations – hemoglobin % (Hb%), total leukocyte count (TLC), neutrophils, lymphocytes, eosinophils, and erythrocyte sedimentation rate (ESR) were performed on Day 0 and Day 31.

2.6. Statistical analysis

For the statistical analysis, the Statistical Package for Social Sciences (SPSS) version 16 (SPSS Inc., Chicago, IL, USA) was used. The independent samples *t* test and Mann-Whitney *U* test (for between-subjects designs) and paired samples *t* test and the Wilcoxon test (for within-subjects designs) were done.

3. Results

In present study 40 patients were registered, of which only 37 participants completed the study. The sociodemographic profile of the participants shows that 57.5% (23) were male and the rest 42.5% (17) were females. The age groups of 5–6, 7–8, and 9–10 years consisted of 18 (45%), 27.5% (11), 27.5% (11) participants, respectively. The majority (90%, 36) of the participants belonged to the Hindu religion. Socioeconomic assessment revealed that 37.5% belonged to the lower-middle class followed by 30% in the upper-middle class strata. *Prakriti* (genetic phenotype) yielded the

majority 87.5% (35) were having *Pitta-Kapha Prakriti*. A mixed diet was consumed by 80% (32) of the participants. Sleep patterns showed the 60% (24 participants) slept for around 10 hours/day but 62.5% (25) had disturbed sleep, while 37.5% (15) had normal sleep. The family history of the participants highlighted that 25% (10) had a positive family history of chronic tonsillitis. Duration of tonsillitis revealed that 27.5% (11) participants had a duration of tonsillitis for a period of 3 years or more, 17.5% (7) had a duration of tonsillitis for a period of 2 years or more and 55% (22) had a duration of onset of tonsillitis for a period of 1 year or less. Poor oral hygiene was observed among 67.5% (27) participants and only 10% (4) had good oral hygiene.

Chief complaints reported were throat pain among 10% (4) patients, difficulty in deglutition in 17.5% (7) patients, halitosis in 12.5% (5) patients, fever in 10% (4) patients, breathing difficulty among 20% (8) patients (16.66%) with complaints of mouth breathing in 22.5% (9) patients. Only 5% (2) reported having jugulo-digastric lymphadenopathy and 2.5% (1) having enlarged tonsils. Clinical diagnosis revealed 62.5% (25) patients with chronic parenchymatous tonsillitis, 32.5% (13) patients with chronic follicular tonsillitis and only 5% (2) were diagnosed as chronic fibroid tonsillitis. Within the group (Wilcoxon signed ranks test) statistical significance ($p < 0.05$) on signs and symptoms of chronic tonsillitis was found for KR intervention, but nothing significant was observed with *Godhuma Vati* intervention (Table 1). However, between groups (Mann Whitney U test), the effects of KR on signs and symptoms of chronic tonsillitis was found to be significant ($p < 0.05$; Table 2). Routine laboratory blood investigations assessed within the KR (study group) showed statistical significance ($p < 0.05$) on Hb%, TLC, lymphocytes and ESR, whereas *Godhuma Vati* (placebo) were nonsignificant (Table 3). The comparisons on the effect of KR (study group) and *Godhuma Vati* (placebo group) on laboratory investigations and fever were nonsignificant ($p > 0.05$) as detailed in Table 4.

4. Discussion

CHT is an inflammation of the tonsils caused by a microbial infection. The symptoms are usually mild and often related to the common cold. In streptococcal infection the tonsils often swell and become coated and the throat is sore. The patient has a temperature, foul-smelling breath and may feel quite ill. Therefore drugs with anti-inflammatory and immunomodulatory effects may be useful for treatment of CHT. Ayurveda, as well as recent experimental results indicate the ingredients of a poly-herbo-mineral formulation KR as having anti-inflammatory, antimicrobial, and immunomodulatory effects. It is substantiated by the clinical observations among tonsillitis patients. The key ingredients being the metallic *Bhasmas* (purified calx), like *Swarna Bhasma*, is prepared by incinerating gold processed with herbal preparations.^{18,19} *Swarna Bhasma* promotes immunity through phagocytosis.²⁰ Gold

poly-herbal formulations are found to increase vitality and immunity.²¹ The clinical applications of *Swarna Bhasma* and gold salts in Ayurveda are known for rejuvenation and immunomodulation for some chronic diseases.²² Gold nanoparticles have significant applications in targeted drug delivery.^{23,24} *Swarna Bhasma* contains gold particles in the size range of nanoparticles.²⁵ Recent studies show that *Swarna Bhasma* contained not only gold, but also several microelements (Fe, Al, Cu, Zn, Co, Mg, Ca, As, Pb, etc.). Animal model studies show *Swarna Bhasma*-treated animals significantly increased superoxide dismutase and catalase activity, which are responsible for reducing free radical concentrations in the body.¹⁹ The antioxidant effect of *Swarna Bhasma* is considered to be one of the mechanisms for the immunomodulatory mode of action of the formulation. *Rajata Bhasma* (silver calx) is a nanoparticulate complex of silver along with Sn, Cd, Mg, K, Na, S, Ca, P, Si, Al, Cl, Ar, In, Fe, Cu, Ba, Hg, or Cr.²⁶ Recent scientific trends indicate emergence of metallic silver in the form of silver nanoparticles as a potential antimicrobial agent, specially important, as several pathogenic bacteria have developed resistance against various antibiotics.²⁷

Herbal components like *Amalaki* (*Phyllanthus embellica*)^{28,29} and *Guduchi* (*Tinospora cordifolia*)³⁰ are having nourishing and rejuvenative property. Experimental studies reveal their immunostimulant activity which combats sepsis in animals.^{31–36} *Vacha*, *Sunthi*, *Pippali*, *Ashwagandha*, *Yasthimadhu*, *Amalaki*, and *Haritaki* all have immunomodulatory properties.^{37–40} *Pippali* is an important drug for the treatment of cough, common cold, and is useful as a digestive. The active principle piperine is known for its bio-enhancing and anti-inflammatory effects.⁴¹ *Yasthimadhu* is a prominent *Rasayana* known for its immunomodulatory, anti-inflammatory, anti-allergic and antiviral activities. It also enhances permeability in drug delivery systems.⁴² *Yasthimadhu* (*Glycyrrhiza glabra*) also has cytoprotective and demulcent effects and is a popular home remedy for minor throat infections. Biologically active substances in liquorice root include glycyrrhizic acid (GL) and its aglycone (GA), phenolic compounds, oligosaccharides and polysaccharides, lipids, sterine, etc. Many researchers have suggested that the effects on the production of interferon (IFN) and Th2 cytokines might be one of the mechanisms involved in the anti-infective process. Recently, glycyrrhizin has been found to be active in inhibiting replication of the severe acute respiratory syndrome (SARS)-associated virus (FFM-1 and FFM-2) and also H5N1 influenza A virus-infected cells. GL is also reported to have modulatory effects on the complement system. Reports indicate that GL blocks C5 or a more distal stage of the complement cascade, suggesting that it might have a role in preventing tissue injury not only in chronic hepatitis, but also in autoimmune and inflammatory diseases. Chemical modification of GL and GA has been tried, and a significant improvement in anti-inflammatory, antiallergic, and antiulcer activities was observed. These observations indicate immune-modulating and biological response modifier activities associated with GL. *Tinospora cordifolia* (TC) is known for its immunomodulatory and cytoprotective activities. Quaternary alkaloids and biotherapeutic diterpene glucosides of TC (syringin, cordiol, cordioside, and coriofolioside) showed an immunopotentiating activity. Research work has been conducted on berberine, jatrorrhizine, tinosporaside, and columbin, which shows a possible mechanism of immunomodulatory activity as an activation of macrophages, leading to increases in granulocyte-macrophage colony-stimulating factor (GM-CSF), leukocytosis, and improved neutrophil function. TC also inhibits C3 convertase of the classical complement pathway. Research on polysaccharide (α -D-glucan) derived from TC shows the activation of nuclear killer (NK) cells, complement system, and Th1 pathway cytokines, coupled with low nitric oxide synthesis.⁴³ *Aswagandha* has shown promising

Table 1
Effect of *Kumarabharana Rasa* and *Godhuma Vati* on signs and symptoms of chronic tonsillitis (BT & AT) – test statistics within the groups (Wilcoxon signed ranks test).

Sign and symptoms	<i>Kumarabharana Rasa</i>		<i>Godhuma Vati</i>	
	Z	P (2-tailed)	Z	P (2-tailed)
<i>Kathina Shotha</i> (enlargement of tonsils)	-3.100	0.002	-1.414	0.157
<i>Ragatwa</i> (hyperemia)	-3.256	0.001	-1.890	0.059
<i>Galoparodha</i> (dysphagia)	-3.580	0.000	-0.378	0.705
<i>Mukha Daugandhya</i> (halitosis)	-3.341	0.001	0.000	1.000
<i>Lasikagranthi Vridhhi</i> (enlargement of lymph nodes)	-3.473	0.001	-1.633	0.102

Table 2
Comparison on the effect of *Kumarabharana Rasa* (study group) and *Godhuma Vati* (placebo group) on signs and symptoms – test statistics^b between the groups (Mann Whitney U test).

BT & AT	<i>Kathina Shotha</i> (enlargement of tonsils)	<i>Ragatwa</i> (hyperemia)	<i>Galaparodha</i> (dysphagia)	<i>Mukha Daurgandhya</i> (halitosis)	<i>Lasikagranthi</i> <i>Vridhhi</i> (enlargement of lymph nodes)
Mann-Whitney U	60.000	101.500	50.000	54.000	65.500
Wilcoxon W	213.000	254.500	203.000	207.000	218.500
Z	-3.856	-2.335	-3.910	-3.932	-3.465
Asymp. Sig. (2-tailed)	0.000	0.020	0.000	0.000	0.001
Exact Sig. [2*(1-tailed Sig.)]	0.001 ^a	0.036 ^a	0.000 ^a	0.000 ^a	0.001 ^a

^a Not corrected for ties.

^b Grouping variable: group.

Table 3
Effect of *Kumarabharana Rasa* and *Godhuma Vati* on laboratory investigations and fever in chronic tonsillitis (BT & AT) – paired samples test (within group).

Parameters	<i>Kumarabharana Rasa</i>				<i>Godhuma Vati</i>			
	Mean difference	Std. deviation	Std. error mean	<i>p</i>	Mean difference	Std. deviation	Std. error mean	<i>p</i>
Hb%	-0.34000	0.69008	0.15431	0.040	-0.16471	.86092	.20880	0.442
TLC	1.83700	3174.19878	709.77242	0.018	5.35294	2708.9991	657.02881	0.427
Neutrophils	4.00000	9.48683	2.12132	0.075	0.58824	7.53375	1.82720	0.752
Lymphocytes	4.30000	8.54770	1.91132	0.037	-3.35294	7.38191	1.79038	0.079
Eosinophils	0.40000	1.14248	0.25547	0.134	0.70588	1.53153	0.37145	0.076
ESR	1.08000	16.80413	3.75752	0.010	1.64706	10.32558	2.50432	0.520
Temperature	0.39500	0.87327	0.19527	0.057	-0.08235	2.47897	0.60124	0.893

Table 4
Comparison on the effect of *Kumarabharana Rasa* (study group) and *Godhuma Vati* (placebo group) on laboratory investigations and fever – independent samples test (between groups).

Differences BT & AT	<i>t</i>	Sig. 2-tailed (<i>p</i>)	Mean diff.	Std. error diff.
Hb%	-0.688	0.496	-0.17529	0.25496
TLC	1.328	0.193	1301.70588	979.95025
Neutrophils	1.560	0.128	4.31176	2.76446
Lymphocytes	-0.357	0.723	-0.94706	2.65088
Eosinophils	-0.695	0.492	-0.30588	0.44022
ESR	1.952	0.059	9.15294	4.68889
Temperature	0.778	0.442	0.46088	0.59237

immunomodulatory effect in inflammatory experimental models.⁴⁴ Sunthi (*Zingiber officinalis*) has anti-inflammatory property which inhibits LPS-induced NF- κ B activation by preventing degradation of the κ B- α , as well as the phosphorylation of ERK1/2, SAPK/JNK, and p38 MAPKs which were associated with a decrease in the expression of inducible nitric oxide synthase (iNOS) and cyclooxygenase-2 (COX-2).⁴⁵ Vacha (*Acorus calamus*) is reported for its inhibitory effect on mast cell-dependent anaphylactic reactions in allergic reactions of the respiratory tract.⁴⁶ Amla (*Phyllanthus emblica*) has been reported to suppress the expression of LPS-induced pro-inflammatory genes (COX-2, iNOS, TNF- α , IL-16, and IL-6) in RAW 264.7 murine macrophage cells in a dose-dependent manner.⁴⁷ Honey is known to enhance the action of these medicines, and has a potential immunomodulatory effect.^{48–51}

5. Conclusion

Thus the poly-herbo-mineral formulation KR has a combined mechanism of action on tonsillitis by reducing the number of attacks. From the Ayurvedic perspective it controls the imbalance of *Doshas* and thus effectively reduces the signs and symptoms of chronic tonsillitis. However, following the reverse pharmacological perspective we find scientific evidence of its components against inflammation and microbial invasion via multiple mechanisms mostly as immunomodulators, as discussed above. Future studies

on KR formulation along the lines of reverse pharmacology may produce more conclusive information about its combined mechanism of action at the molecular level.

Conflicts of interest

All authors have no conflicts of interest to declare.

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