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RESEARCH ARTICLE

IRON DEFICIENCY ANAEMIA AMONG INDIAN POPULATION AND ITS AYURVEDIC MANAGEMENT.

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Abstract

Presently India is leading in the world in the context of iron deficiency anaemia because more than 50% of its population is suffering from it. This silent killer is very common among Indian rural population due to poor socioeconomic status, inadequate dietary habits, worms infestation and GI bleeding. After ruling out the cause of anaemia, *SwarnamakshikaBhasma* prepared by different *Shodhana* and *Marana* processes and one purchased from market (control group) were administered in the dose of 250mg BD in three groups of 20 patients each randomly selected from the OPD & IPD of Govt. Ayurvedic College & Hospital, Patna. On comparing the overall effect of therapy in three groups, it was observed that 70.58% patients in Gr. A, while 64.7% in Gr. B and 56.25% in Gr. C got cured. Clinically, *SwarnamakshikaBhasma* used in Gr. A showed better haematinic effect than Gr.- B & Gr.- C. It could be a drug of choice for the treatment of anaemia due to easy availability and cheaper price.

Introduction:-

Globally 30% of total world population is anaemic and half of them nearly 600 million people are suffering from iron deficiency anaemia[i]. It is one of the most important public health problems not only in India but also in the most of the South East Asian countries. It also increases the maternal morbidity and faetal and neonatal mortality and morbidity significantly. Nearly half of the pregnant women in the world are anaemic, 52% of the non industrialised as compared to 23% of the industrialised population. However according to WHO, prevalence of anaemia in pregnancy in South East Asia is around 56%. In India incidence of anaemia during pregnancy has been noted as high as 40-80%. 15-22% of maternal mortality has been estimated due to anaemia during pregnancy. *(Source-Health Information of India, 2004).*

Although the primary cause of anaemia is iron-deficiency, it is seldom present in isolation. More frequently it coexists with a number of other causes, such as malaria, parasitic infection, nutritional deficiencies, and haemoglobinopathies. The importance of iron-deficiency as cause of anaemia varies by region. While as low as 50% of anaemia in sub-Saharan Africa may be attributable to iron-deficiency (due to high prevalence of HIV, hookworm,

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malaria, and other infectious diseases) the proportion of anaemia caused by iron-deficiency increases to over 70% among premenopausal women in India[ii-iii].

According to the World Health Organization's 2009 Global health risks' report[iv], iron-deficiency anaemia accounted for 400,000 deaths and 1.5% of the global Disability Adjusted Life Years in 2004. IDA is the most common nutritional problem in world and mainly affects woman of child bearing age (especially during pregnancy and lactation) and young children.

Iron-deficiency also has important consequences for the future generations, as iron-deficiency anaemia increases the risk for preterm labour, low birth weight, infant mortality and predicts iron deficiency in infants after 4 months of age[v-vi]. Anaemia, of which iron-deficiency is the major contributor, accounts for 3.7% and 12.8% of maternal deaths during pregnancy and childbirth in Africa and Asia, respectively[vii]. It also leads to cognitive deficits and reduced intellectual performance among school children[viii]. IDA impairs the mental development of over 40% of the developing world's infants. It decreases the health and energy of approximately 500 million women globally and leads to approximately 50000 deaths in child birth each year. In communities where iron-deficiency is highly prevalent, successful iron supplementation results in the disappearance of anaemia as a public health problem except where malaria and HIV or hookworm infection rates are high[ix].

The World Health Organization defines iron-deficiency anaemia as a condition whereby either individual haemoglobin levels are two standard deviations below the distribution mean, or more than 5% of a given population has haemoglobin levels that are two standard deviations below the distribution mean, in an otherwise normal population of individuals from the same gender and age, living at the same altitude[x]. Significant public health implications are more commonly associated with moderate to severe anaemia, defined as haemoglobin level below 10 g/dL.

Despite increased national and international awareness and recent governmental intervention programs, the prevalence of anaemia among Indian women has remained higher than 45% since 1990, and anaemia trends remain strongly correlated with iron-deficiency[xi-xii]. A 2007 Indian government "12 by 12 initiative", aimed at ensuring that all Indian adolescents have 12 g/dL haemoglobin by 2012, listed the main causes of anaemia in India as low dietary intake, poor availability of iron, chronic blood loss due to hookworm infestation, and malaria[xiii].

Vegetarianism, defined as the exclusive consumption of plant-based diets, is a common dietary pattern in India, dating back to at least 2500 years. In India, vegetarianism is influenced in part by adherence to the ethical teachings of ahimsa or "nonviolence" inherent in Hinduism, Buddhism, and Jainism. Vegetarian-style diets constitute a common dietary pattern in India, dating back to at least 2500 years, with Indians constituting about 70% of the world's population who adhere to vegetarian-style diets. About 75% of Indian vegetarians are lactovegetarians (i.e., do not consume meat or eggs, with no prohibition for milk or other dairy products), with up to 25% being lactovovegetarians (who do not eat meat, with no prohibition on eggs and dairy products). Less than 1% of Indians are vegans, who do not eat any animal products at all[xiv]. Vegetarianism has important implications for maternal iron-deficiency in India, in terms of the availability and chemical form of iron in plant-based foods. Although a vegetarian diet is likely to contain iron in amounts equivalent to that in omnivorous diets, animal-based haemoglobin iron is better absorbed (15–40% absorption) compared with plant-based non haemoglobin iron (1–15% absorption), despite variations in body iron stores[xv]. Nutritionists recommend that vegetarians need to increase dietary iron by 80% to compensate for a lower iron availability of 10% from a vegetarian diet compared with 18% from an omnivorous diet[xvi]. This recommendation constitutes a major challenge in India where the majority of vegetarians subsist on inadequate quantities of iron-poor staples such as lentils, wheat bread, green peppers, and rice.

A modified food guide pyramid for vegetarians entails obtaining 32–36 mg of iron daily in a 2000 calorie diet containing 8 servings of grains, 3 of vegetables, 2.5 of green leafy vegetables, 1.5 of fruit, 2.5 of beans and protein foods, 3 of dairy or nonfortified dairy, 1.5 of nuts and seed, and 2.5 of oils[xvii]. The vast majority of Indian vegetarians are unable to afford to eat such varied vegetarian meals in the quantities suggested. In addition, affordable foodstuffs such as wheat bread contain high levels of phytates, while tea, a popular beverage in India, is high in tannic acid content. Phytates and tannins inhibit iron absorption[xviii].

Most of the Indian staple foods are produced or grown locally, and most commonly consumed foods are not fortified with iron. A popular food item in India is beans. Beans have relatively high iron content, but only 2% is absorbed

from the most commonly consumed variety of beans in India, *Phaseolus vulgaris*. Other varieties of beans, such as soyabean, are more easily absorbed—iron absorption from *soyabeans* is about 30% in iron deficient women, which is similar to that from meat or iron sulphate tablets, because 90% of the iron in soybeans is in the form of ferritin—*soyabean* is not a popular food item in India[xix]-[xx].

Iron deficiency anaemia has been defined as iron store depletion refers to an imbalance between normal physiological demands and the level of dietary iron intake. Iron deficiency causes ***defective haemoglobinisation*** which leads to ***Microcytic Hypochromic Anaemia.***

1. Reduced MCV (<78-95 fl)
2. Decreased MCH (<27-32 pg)
3. Decreased MCHC (<30-35 gm/dl)

Etiology[xxi] –

1. Defective intake- children, psychiatric patients, patients having anorexia
2. Defective absorption- Gastrectomy, gastrojejunostomy, sprue syndrome
3. Excessive demand- Growing children, female during reproductive years, thyrotoxicosis
4. Excessive loss- hookworm anaemia, bleeding piles, hiatus hernia, iron sequestration, pulmonary haemosiderosis, menorrhagia, recurrent haematemasis and malaena, recurrent blood donation

Morphological Classification of Anaemia[xxii].

Morphological type of anaemia	Underlying abnormality	Clinical syndrome	Treatment
1. Macrocytic (MCV>94fl & MCHC> 31gm/dl) A) Megaloblastic	1.) Vit B_{12} deficiency 2.) Folic acid deficiency 3.) Inheritated disorder of DNA synthesis	Pernicious anaemia, Nutritional, Megaloblastic, Sprue, Malabsorption Syndrome etc	• Vit B_{12} • Folic Acid • As per disorder stopping offending drugs • Treatment of underlined disorder
B) Non Megaloblastic	1) Accelerated erythropoesis 2) Increased membrane surface area	Haemolytic anaemia response to haemorrhage	
2. **Hypochromic Microcytic** **(MCV<80fl & MCHC<31gm/dl)**	***1) Iron Deficiency Anaemia*** 2) Disorder of globin synthesis 3) Disorder of porphyrin & haem synthesis 4) Other disorders of iron metabolism	Chronic loss of blood, inadequate diet, Impaired absorption and increased demand, Thallassemia alone or with haemoglobinopathies, Pyridoxine responsive anaemia, Frequent pregnancy, Overhydration according to the cause	Ferrous Sulphate & Correction of underlying disease, Transfusion, ***Iron correction of underlying condition restores haemostasis***
3. Normochromic & Normocytic (MCV= 82-92fl & MCHC>30 gm/dl)	1) Recent blood loss 2) Over expansion of plasma volume 3) Haemolytic disease 4) Hypoplastc bone marrow 5) Endocrine abnormality 6) Chronic disorder 7) Renal disease	Causes- Aplastc anaemia, Pure red cell aplasia, Leukaemia, Multiple Myeloma, Myelofibrosis, Hypothyroidism, Adrenal insuffiency, Renal disease, Cirrhosis	A/c to the nature of disorder- Transfusion, treatment of underlying disease, Chemotherapy

	8) Liver disease		

In the Indian context it is particularly a major cause of concern among masses. Inadequate dietary intake, blood loss due to various reasons and decreased iron absorption are major cause of anaemia or *Panduroga.* Acharya Caraka has said in the context of *Panduroga*-

Ksharamlalavanayushna……sa panduroga etyuktah[xxiii].
Swarnamakshika ($CuFeS_2$) has been described for the treatment of *Panduroga* i.e. Iron Deficiency Anaemia in various classics of *Ayurveda*. e.g. *Rasa Tarangini, Ayurveda Prakasha, Rasendra Chudamani etc.*

Swarnamakshika vrishyam……yogvahi param matam.[xxiv]
It contains extrinsic factor such as copper and iron, required for the formation of haemoglobin. Being a *Saumyakalpa*[xxv] of iron, it is easily digestible and hence widely used in infants, pregnant, lactating women and frail old people. Easy availability and cheaper price makes it a drug of choice for the treatment of anaemia.

Material and Methods:-

In the present study a clinical trial of *Swarnamakshika Bhasma* (prepared by different *shodhana* and *marana* processes at the pharmacy of G.A.C. & H., Patna) has been carried out for evaluating its efficacy on *Panduroga* i.e. IDA. The patients of IDA were selected from the OPD and IPD of G.A.C. & Hospital, Patna. For this a clinical proforma was prepared incorporating selected symptoms and signs based on both *Ayurvedic* and modern parameters.
Laboratory investigations-

1. CBC -
2. Urine- Routine and Microscopic
3. Stool- Routine examination for ova & cysts, for occult blood were carried out.

Inclusion Criteria-

1. Patients willing for trial
2. Patients having signs & symptoms of IDA
3. Laboratory investigations of blood suggesting IDA

Exclusion Criteria-

1. Hb% below 7gm/dl
2. IDA with Cardiac complication, DM, TB and Malignancy
3. IDA with a case of defective absorption like gastrectomy, gastrojejunostomy, sprue syndrome etc

Trial Groups-

Total 60 patients were selected for the present study that fulfilled inclusion criteria. All the selected patients were studied in 3 groups of 20 patients each. Out of 60 registered patients, 10 dropped out the trial.
Group A- Swarnamakshika Bhasma *(*prepared through *Shodhana by Kadlikanda swarasa*[xxvi] *and marana by Hingula & Nimbu swarasa*[xxvii]*)*
Group B- Swarnamakshika Bhasma *(*prepared through *Shodhana by Nimbu swarasa*[xxviii] *and marana by Nimbu swarasa*[xxix]*)*
Group C- Control Group Swarnamakshika Bhasma *(purchased from market)*
In all the groups, *Amalaki Churna* 3gm BD was given at the time of drug administration. (Here Vitamin C of *amalaki churna* improve the absorption of non- haem iron)

Mode of administration- Oral *(in gelatinous capsule form)*
Duration of trial- 45 days
Follow up- After 15 days
Instructions to the patients-

1. Drug should be taken 1hr before or 3 hr after taking food.
2. Milk should not be taken be taken before and after drug administration.
3. Antacids should be avoided during the treatment schedule.
4. Vitamin C enriched foods are advised to take.

Criteria of Assessment-

For the purpose of assessment of improvement, a scoring system in sign and symptoms of IDA i.e. *Panduroga* was adopted. Further it was assessed by evaluating already mentioned laboratory findings, which were carried out at the time of inclusion and initiation of trial in the patient and during treatment on every fifteen days up to completion of trial. Untoward effect of the drug if any, were also noted on each and every visit. All the patients treated were also followed up for 15 days after completion of trial to assess the any effect which developed later on.

The data related to the clinical features and laboratory investigations was collected and then statistically analyzed. The status of IDA was assessed on the basis of grades of various variables compared between pre and post trial values in terms of percentage. Values between two variables were compared with student (t) test for dependent samples by using the degree of freedom, p value (two tailed)[xxx]. The results were expressed in terms of mean, standard deviation (SD±) and standard error (SE±)

Observation and Results:-

Table no- 1 Sex wise distribution of patients

Sex	Number of patients			%age Change
	Gr A	Gr B	Gr C	
Male	5	4	4	21.66
Female	15	16	16	78.33

Table no- 2 Habitat wise distribution of patients

Habitat	Number of patients			%age Change
	Gr A	Gr B	Gr C	
Rural	15	16	17	80
Urban	5	4	3	20

Table no- 3 Occupation wise distribution of patients

Occupation	Number of patients			%age Change
	Gr A	Gr B	Gr C	
Students	4	4	3	18.33
Employee	2	2	3	11.66
Labourers	1	3	3	11.66
Housewives	13	11	11	58.33

Table no- 4 Education wise distribution of patients

Category	Number of patients			%age Change
	Gr A	Gr B	Gr C	
Illiterates	1	2	1	6.66
Primary	5	6	5	20
Matriculation	3	4	6	21.66
10+2 pass	6	3	5	23.33
Graduate	3	3	2	13.33
P. G.	2	2	1	8.33

Table no- 5 Addiction wise distribution of patients

Addiction	Number of patients			%age Change
	Gr A	Gr B	Gr C	
Tea/ Coffee	10	15	12	61.66
Smoking	1	0	1	3.33
Alcohol	1	1	0	3.33
Tobacco chewing	2	2	3	11.66
No addiction	6	2	4	20

Since the main aim of present clinical study was to evaluate the effect of trial drugs on *Microcytic Hypochromic Anaemia*, so the haematological analysis, data of haemoglobin and Red Cell Indices i.e. *Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH) and Mean Corpuscular Haemoglobin Concentration (MCHC)* are given here.

Table no- 6 Effect of trial drug on Haemoglobin (in gm/dL)

Groups	No. of Pt.	Mean		%age Change	SD ±	SE ±	T	P
		B.T.	A.T.					
Gr. A	17	9.47	11.57	22.16	1.06	0.25	8.12	<0.001
Gr. B	17	9.41	11.45	21.68	0.86	0.21	9.7	<0.001
Gr. C	16	9.68	11.16	15.24	0.75	0.18	7.81	<0.001

The above data depicts that the initial mean score of Haemoglobin (in gm/dl) in Gr. A was 9.47 which increased to 11.57 after treatment showing change of 22.16%. In Gr. B, initial mean score was 9.41 which increased to 11.45 after treatment showing change of 21.68%. In Gr. C (control group), the initial mean score was 9.68 which increased to 11.16 after treatment showing change of 15.24%. The result was statistically highly significant in all the three groups.

Table no- 7 Effect of trial drug on MCV (in fL)

Groups	No. of Pt.	Mean		%age Change	SD ±	SE ±	T	P
		B.T.	A.T.					
Gr. A	17	78.44	84.43	7.62	3.38	0.82	7.27	<0.001
Gr. B	17	77.12	86.26	8.98	3.6	0.87	8.12	<0.001
Gr. C	16	80.16	84.00	4.77	2.97	0.74	4.01	<0.001

Table no- 8 Effect of trial drug on MCH (in pg)

Groups	No. of Pt.	Mean		%age Change	SD ±	SE ±	T	P
		B.T.	A.T.					
Gr. A	17	25.6	28.44	11.07	1.44	0.34	8.1	<0.001
Gr. B	17	26.18	28.78	9.9	2.07	0.5	5.16	<0.001
Gr. C	16	25.96	27.58	6.23	1.64	0.44	3.92	<0.01

Table no- 9 Effect of trial drug on MCHC (in gm/dL)

Groups	No. of Pt.	Mean		%age Change	SD ±	SE ±	T	P
		B.T.	A.T.					
Gr. A	17	31.66	33.12	4.83	0.85	0.2	7.42	<0.001
Gr. B	17	31.2	32.44	3.95	0.63	0.15	7.99	<0.001
Gr. C	16	31.1	31.88	2.51	0.84	0.21	3.7	<0.01

Table no- 10 Overall effect of therapy in three groups

Results	No. of patients			Percentage %		
	Gr. A	Gr. B	Gr. C	Gr. A	Gr. B	Gr. C
Cured	12	11	9	70.58	64.7	56.25
Marked improvement	3	4	4	17.64	23.52	25
Improvement	2	2	3	11.76	11.76	18.75
Unchanged	0	0	0	0	0	0

On comparing the overall effect of therapy in three groups, it was observed that 70.58% patients in Gr. A, 64.7% in Gr. B and 56.25% in Gr. C got cured. 17.64% of patients in Gr. A, 23.52% in Gr. B and 25% in Gr. C shown marked improvement. 11.76% each in Gr. A and Gr. B followed by 18.75% in Gr. C shown improvement. No patients remained unchanged after completion of therapy.

Discussion:-

It was observed from the present study that the majority of the patients suffering from IDA were women (78.33%) while only 21.66% male were suffering from it (Table no- 1). 80% registered patients were of rural background

whereas only 20% were from urban background (Table no- 2). The people of nearby rural area visited the hospital for various ailments frequently. Some of them incidentally diagnosed of IDA. It also shows more prevalence of IDA among rural population.

Occupation plays an important role in manifestation of various diseases. In registered patients (Table no- 3), maximum were housewives (58.33%) followed by 18.33% students, 11.66% labourer and employee each. This shows that incidence of IDA is maximum in housewives as they do not care of their health due to ignorance and incidentally came to know regarding it.

Most of the patients (23.33%) were educated up to higher secondary followed by matriculation (21.66%), primary education (20%), graduate (13.33%), higher study 8.33% and illiterate 6.66% (Table no- 4). The possibility of IDA was maximum in less educated people as they have lack of knowledge about the importance of micronutrients in the body.

It was observed as per Table no- 5, that 61.66% patients had addiction of either tea or coffee. It has already been proved through various researches that tannins formed by tea, phosphates of egg yolks and phytates of bran causes poor bioavailability and finally leads to reduction in the absorption of iron. This could have been the cause of more prevalence of IDA in tea addicted people in the present study.

In this study, it was also observed that incidence of IDA was maximum in patients having poor hygienic condition (65%) followed by 35% patients had good hygiene. Further 60% were taking mixed diet and only 40% were vegetarian.

Since ancient time *Swarnamakshika Bhasma* is the most widely used *Bhasma* preparation in *Panduroga* i.e. IDA. A research work relating to its safety and toxicity profile on experimental animals has been studied *(Ref- Studies on the Bhasma of Makshika and Makshika Satva by- Dr. A.K. Choudhary, Faculty of Ayurveda, IMS, BHU)*. But till date its therapeutic efficacy in human beings by employing different methods of *Shodhana* and *Marana* has not been established. So here a clinical study has been done to evaluate the efficacy of *Swarnamakshika Bhasma* (prepared by employing different *shodhana & marana* processes) in the context of IDA i.e. *Panduroga.*

In this study *Panduroga* has been selected for the clinical trial of *Swarnamakshika Bhasma* for evaluating therapeutic effectiveness because *Lauha* preparation are considered as the best remedy of *Panduroga*. Here *Panduroga* is co-related with iron deficiency for their etiological, symptomatic and management similarities.
Etiological similarities-

Excessive intake of *kshara* and *lavana* reduces absorption of iron by neutralising gastric acidity. Excessive exercise may cause excessive demand or iron. Affliction of mind with *shoka, chinta, bhaya,* may cause defective intake of iron due to anorexia.

Symptomatic similarities-

1. General symptoms like *Pandutta* (Pallor), *Daurbalya* (Weakness), *Shrama* (Fatigue), *Shotha* (Oedema), *Twakasphotana* (Dry skin) etc
2. Cardiovascular features like *Hridayaspandana* (Palpitation), *Shwasa* (Breathlessness)
3. G.I. symptoms like *Aruchi* (Anorexia), *Amlodgara* (Acidity)
4. Neurological features like *Bhrama* (Giddiness), *Tama* (Fainting)

Management Similarities- *Raktaranjana* (Haematinic) regimens are prescribed for both *Panduroga* and IDA.

Effect of trial drugs on Clinical Features (%age Relief)

Symptoms(→) Groups(↓)	Fatigue	Pallor	Palpitation	Tinnitus	Anorexia	Giddiness	Irritability	Dyspnoea
Gr. A	77.78	86.36	58.0	60.0	80	57.9	78.94	55.56
Gr. B	82.14	79.16	66.67	57.14	83.34	61.2	71.42	58.83
Gr. C	68.75	63.64	60.0	71.42	73.4	52.6	60	52.63

Effect of trial drugs on Haematological Parameters (%age change)

Symptoms(→)	HGB	MCV	MCH	MCHC

Groups(↓)				
Gr. A	22.16	7.62	11.07	4.83
Gr. B	21.68	8.98	9.9	3.95
Gr. C	15.24	4.77	6.23	2.51

Probable mode of action of trial drugs-

Swarnamakshika Bhasma
Madhura, Tikta rasa
Laghu, Sheeta Guna
Sheeta Virya
Increases *Rasa Dhatu* Formation

Increases *Rakta Dhatu*

Cures *Pandu*roga

Probable mode of action (A/c to Modern concept)-

Swarnamakshika Bhasma (Oxides of Iron and Copper)
Taken in empty stomach (increased amount of gastric acids)
with *Amalaki Churna* (richest source of Vitamin C)
Converts Ferric Iron to soluble Ferrous form

Increased uptake of Membrane Trasnferrin Receptors[xxxi]

Increased Iron absorption and distribution in body

Increased Haemoglobinisation

Cures *Microcytic Hypochromic Anaemia*

Conclusion:-

It can be concluded from the present study that clinically, *Swarnamakshika Bhasma* used in Gr. A was better as compared to Gr. B. The *Bhasma* used in Gr. A showed better haematinic effect than Gr. B. It could be a drug of choice for the treatment of anaemia due to easy availability and cheaper price. It was noticed that all the patients tolerated the treatment quite well and no adverse reaction to the drugs were observed during the course of treatment. The above mentioned results should be further analyzed by conducting such study in large number of patients with a longer period of follow up to observe any untoward effect of drugs. It is further suggested to evaluate haematological effect of these drugs by conducting Serum Ferritin and TIBC investigations.

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