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Review Article

A CONCEPTUAL STUDY OF *RANJAKA PITTA* AND ITS CORRELATION WITH ERYTHROPOISIS

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ABSTRACT

Tridosha, *Sapthadhatu* and *Trimala* are the fundamental constituents of the body. The body is made up of three fundamental elements: *Vata*, *Pitta* and *Kapha*; which stay unchanged from birth to death. *Pitta Dosha* plays a crucial role in digestion and metabolism. *Ranjaka Pitta* is one of the five subtypes of *Pitta* that contribute to *Ranjana Karma*. The seven stages of *Raktotpatti* (Erythropoiesis) and the colour transition. *Acharya Sharangadhara* explained the stories from *Shweta* to *Aalaktaka* in detail. Erythropoiesis is the process by which uncommitted pluripotent hematopoietic stem cells develop into RBCs. Erythropoiesis is caused by the intrinsic factor of castle, vitamin B12, iron and other compounds in the stomach, liver and spleen. This article explores the link between functions of *Ranjaka Pitta* and erythropoiesis-related variables. According to many *Acharya*; the *Ranjaka Pitta* in *Amashaya*, *Yakruth* and *Pleeha* practices *Rasa Ranjana Karma* and *Raktothpatti*. *Ranjaka Pitta* may refer to the stimulant and maturation factors present in the stomach, liver and spleen that help produce red blood cells.

INTRODUCTION

Ayurveda is an ancient discipline centred on *Tridosha Siddhantha*. The *Tridosha* (*Vata*, *Pitta*, and *Kapha*) govern the human body from ovulation to death [1]. All physiological functions are complete. *Tridosha* maintains a regular condition. In a vitiated form, they poison the whole body and cause sickness [2]. *Vata*, *Pitta*, and *Kapha* are directly responsible for *Vyadhi* and *Swasthya*, which govern the body's production, preservation and destruction. The *Tridosha* support the *Sharira*, similar to how pillars support a home. They are located in the lowest, middle, and top parts of the body [3]. The second *Dosha* triad, *Pitta*, depicts the agents responsible for alterations in biological systems. *Pitta Dosha* regulates digestion, metabolism, maturity and equilibrium.

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Ranjaka Pitta

Table 1: Sites of *Ranjaka Pitta* according to different *Acharya* Name of the *Acharya* [4]

Name of the *Acharya*	Sites
Acharya Vagbata	*Amasaya*
Acharya Sharangadhara	*Yakruth*
Acharya Sushruta	*Yakruth* and *Pleeha (Ranjakagni)*
Acharya Bhavaprakasha	*Yakruth and Pleeha*

The main purpose of *Ranjaka pitta* is to provide red colour to the *Rasa*, resulting in *Rakta*. According to *Kedarakulyanyaya* from *Dhatuparinama*, *Raktadhatu* nutrients are carried to the liver and spleen, then synthesised by the *Raktadathvagni*. *Raktadathvagni* and *Ranjakapitta* are responsible for the creation of *Raktadhatu* [5].

Rakta Dhatu

The Origin of *Rakta Dhatu*

Rakta is created in the *Raktavaha Srotas* (channel that transports *Rakta Dhatu*). *Rasa Dhatu* is formed in *Rasavaha Srotas* by *Rasadhatwagni* interacting with *Ahararasa* and its nutrients. *Teja* section of *Rasadhatu* enters *Raktavaha Strotas* and

becomes *Rakta Dhatu* [6]. According to *Trividha Nyaya* in *Ayurveda, Dhatus* are formed and sustained by *Ahara Rasa. Acharya Charaka's Kshiradadhi Nyaya* (Law of Transformation) explains that *Rasagni* acts on *Rasa Dhatu* and transforms it into *Rakta Dhatu* [7]. *Yakruth* transports nutrients from *Ahara Rasa* and *Rasavaha Srotas*, while *Pleeha* adds colour and makes *Rakta.*According to *Acharya Charaka*, the *Rasa* does not exhibit redness. When the *Tejabhaga* of *Ahararasa* and *Ushma* of *Pitta* act on *Rasa*, it becomes crimson, forming the *Rakta Dhatu. Acharya Sushruta* describes *Rakta* forms in *Yakruth* and *Pleeha* using *Ranjakagni*.

Method of *Rakta* Formation

1. *Suksma Bhaga*
2. *Sthula Bhaga*
3. *Mala Bhaga* [8]

According to *Sargadhara Samhita* (Deepika commentary), *Varnaparivartana* refers to the stages in the development of *Rakta Dhatu. Varnaparivartana* involves a gradual shift in colour over seven days.

1. *Sweta* 2. *Kapota* 3. *Haridra* 4. *Padma* 5. *Kimsuka* 6. *Alaktaka* 7. *Rasaprakhya/Indragopa*

Erythropoiesis

Erythropoiesis refers to the formation, development, and maturation of erythrocytes [9].

Site of Erythropoiesis: During intrauterine life.

- Mesoblastic stage (3rd week to 3 months)
- Hepatic stage (after 3 months)
- Myeloid stage (3rd trimester)

Stages of Erythropoiesis [10]

1. Pro normoblast
2. Early normoblast (basophilic)
3. Intermediate normoblast (polychromatic)
4. Late normoblast (orthochromatic)
5. Reticulocyte
6. Matured RBC

Table 2: Stages of Erythropoiesis

Stages of erythropoiesis	Diameter (µ)	Nucleus	Staining property	Important event
Pronormoblast (Megaloblast)	20	Has 2 or more nucleoli and chromatin network	Basophilic	Synthesis of haemoglobin starts
Early normoblast (Basophilic erythroblast)	15	No nucleoli Dense chromatin network	Basophilic	Nucleoli disappear
Intermediate normoblast (Polychromatic erythroblast)	10 to 12	Further condensation of chromatin network	Polychromophilic or polychromatic	Haemoglobin starts appearing
Late normoblast (orthochromatic erythroblast)	8 to 10	Small with very much condensed chromatin Ink-spot	Acidophilic	Nucleus disappears by pyknosis
Reticulocyte (Immature RBC)	7 to 7.5	Absent	Basophilic	Reticulum is formed Cell enters capillary from site of production
Matured RBC	7.2	Absent	Acidophilic	Reticulum disappears cell attains biconcavity

Factors Necessary for Erythropoiesis [11]

- General factors
- Special maturation factors
- Haemoglobinization factors

General Factors

- Optimum levels erythropoietin
- Mechanism controlling erythropoietin

Special Maturation Factors

- Vit B 12 (extrinsic factor)
- Folic acid
- Intrinsic factor of castle

Vit B 12 (Extrinsic Factor)

- Daily need - 1-2µg
- Sources - Milk, meat, liver of animals
- Also synthesized by bacterial flora
- Absorption- Need intrinsic factor of castle, a glycoprotein secreted by parietal cells of gastric mucosa.

- With it form intrinsic factor- Cyanocobalamin complex
- Bound to sp receptors in ileum and absorbed by endocytosis.
- Storage – In liver and muscle
- Role – required for synthesis of DNA and maturation of nucleus and cell.

Folic Acid

- Daily requirement
- 100µg
- Sources – Leafy veg, pulses, yeasts, liver.
- From breakdown of polyglutamate to monoglutamates.

Intrinsic Factor of Castle

- Intrinsic factor of castle is formed by gastric Cells.
- Deficiency if intrinsic factor occurs in autoimmune cause of failure of secretion of IF. (Pernicious Anemia)

Fate of RBC: After 120 days, the RBC membrane becomes fragile and ruptures in the spleen. Heme and globin are separated, and iron is reused to form bilirubin pigment. This bilirubin is released into the bloodstream as free bilirubin and is quickly absorbed by liver cells. Bile transports conjugated substances from the liver to the gut.

AIMS AND OBJECTIVES

- To study the concept of *Ranjaka pitta* and its function in detail.
- To investigate the role of *Ranjaka pitta* in *Shareera*.
- To study the concept of erythropoiesis.
- To study the concept of *Ranjaka pitta* and its correlation with erythropoiesis.

MATERIAL AND METHODS

This study is based on a review of data collected from classical text and various modern books, magazines, articles and research papers from various journals and various websites. The information available on the internet is also incorporated into the study.

DISCUSSION

The creation of *Rakta* requires two entities: *Ranjaka Pitta* and *Rakta Dhatwagni. Rakta Dhatwagni* produces cellular components other than those that cause blood to be red. *Ranjaka Pitta* supplies colouring ingredients, completing the creation of *Rakta*. This might be connected to heme synthesis specifically. *Ranjaka Pitta* refers to *Pitta's* role in forming red blood cells. The quality of *Rasa* is determined by its *Ahara*, which includes proteins, minerals, and vitamins. Consider iron and its metabolism as crucial components for haemoglobin production. The function of *Ranjaka Pitta* is to absorb iron, i.e. In GIT (*Amasaya*) The intrinsic factor of castle is responsible for iron transport and storage in liver and reticulo-endothelial cells. *Ranjaka Pitta* concentrated its activities on the areas of *Amasaya, Yakrit,* and *Pleeha. Raktagni* produces cellular components different than those that cause blood to be red. This involves the creation of white blood cells, platelets, etc. All of them do not contribute to *"Ragatvam"* in *Raktha.* They have different functions. *Raktha Dhathu* is referred to as "*Jeevana*" due to its crucial purpose. This function is assigned only to RBCs and Hb. WBCs have both protective and defensive functions, whereas platelets only have clotting mechanisms. It is more closely connected to *Bala* and *Vyadikshamatva*. There are four significant alterations that occur during erythropoiesis. Reduction in cell size disappearance of nucleoli and nucleus. The appearance of haemoglobin Change in cytoplasm staining properties.

According to Acharya Charaka

Rasa becomes crimson when the Teja component of *Ahararasa* and *Pitta's Ushmata* act upon it. This creates the *Rakta Dhatu*. Proteins are necessary for haemoglobin synthesis. Amino acids from this protein are necessary for the formation of the globin component of haemoglobin. Iron is required for the production of the heme portion of haemoglobin. Copper is important for iron absorption from the gastrointestinal system. Cobalt and nickel are required for the absorption of iron from the gastrointestinal system. This contributes to the synthesis of haemoglobin. So, the *Teja Bhaga* of *Ahararasa*, as indicated by *Acharya Charaka*, may be responsible for this biotransformation. Erythropoietin is the stimulating factor for erythropoiesis. The kidney's peritubular capillaries secrete the majority of the erythropoietin. A little amount is also released by the liver and brain. Castle intrinsic factors serve as a maturation factor for erythropoiesis. It is required for the absorption of vitamin B12 (known as extrinsic factor) from the GI tract into the bloodstream. This contributes to the production of mature RBC. This might be connected to the *Ushma* of *Pitta* reported by *Acharya*.

According to Acharya Sushruta

Acharya stated that the *Apya Bhaga* of *Rasa* reaches the *Yakruth* and *Pleeha* absorbs the hue of *Raga*, becoming the *Rakta*. *Ranjakagni* is indicated by the presence of red blood in the body. The third month of intrauterine life is known as the hepatic stage, in which the liver and spleen collaborate to make red blood cells. After 120 days, the RBC is destroyed in the reticuloendothelial system, notably in the spleen, and the haemoglobin is degraded in the reticuloendothelial

cells, splitting into globin and heme. Globin is used for the resynthesis of haemoglobin. Heme degrades into iron and porphyrin. Iron is accumulated in high concentrations in reticuloendothelial cells and liver hepatocytes. Iron is stored as ferritin and hemosiderin, which are then used to synthesise haemoglobin. Thus, the spleen breaks down RBCs while the liver stores iron, which aids in the production of haemoglobin. This can all be taken as the *Ranjaka Pitta* described by *Sushruta* as being in *Yakruth* and *Pleeha*.

According to *Acharya Vagbhata*

Pitta in the *Amashaya* contributes to *Rasa's Ranjana Karma*. Castle intrinsic substances produced by parietal cells of the gastric glands play a key role in erythropoiesis, which is also found in the small intestine and produced by argentaffin cells or enterochromaffin cells. It is important for vitamin B12 absorption from the gastrointestinal system into the bloodstream. Vitamin B12 is a key maturation component in erythropoiesis. The absence of intrinsic factor in gastric juice produces vitamin B12 insufficiency, which leads to pernicious anaemia. So gastric glands can be regarded the *Sthana* of *Ranjaka Pitta*, defined by *Ashtanga* as being in *Amashaya*.

According to *Sharangadhara (Deepika commentary)*

Varnaparivartana phases of *Rakta* creation in 7 days by gradually changing colour from *Sweta* to *Aalakthaka* (as shown in table 3). This level of *Varnaparivartana* corresponds to the *Kshiradadhi Nyaya* described by *Acharya Charaka*. Similar to current science, there are six phases of erythropoiesis in which uncommitted pluripotent hematopoietic stem cells progress through several stages before becoming adult RBCs. The growth and maturity of red blood cells from proerythroblast takes 7 days. The cytoplasm changes colour from blue to pinkish red as the cell matures due to increased haemoglobin expression. The components required for development, etc., in each step follow the *Khale Kapota Nyaya* (selection process) described by *Charakacharya.*

***Varnapari vartana* (Acc. *to Sharangadhara*)**	**Number of days for *Varnapari vartana***	**stages of Erythropoiesis**	**Colour of cytoplasm (After staining)**	**Number of days for Erythropoiesis**
Sweta	1	Pronormoblast (Megaloblast)	Blue	1
Kapota	2	Early normoblast (Basophilic erythroblast)	Intensely blue due to RNA abundance	2
Harita	3	Intermediate normoblast (Polychromatic erythroblast)	Greyish green due to accumulation of Hb	3
Haridra	4	Late normoblast (orthochromatic erythroblast)	Grey orange/ bright yellow colour	4
Padma	5	Reticulocyte (Immature RBC)	Purple colour or blue red	5
Kimsuka	6	Matured RBC	Red	6
Alaktaka	7	Matured RBC	Red	7

The *Pitta's Rasa* and *Usma* are the primary variables in the production of *Rakta,* with *Yakruth, Pleeha,* and *Amashaya* serving as the organs involved.

CONCLUSION

The main seats for *Ranjaka Pitta* are *Yakrit. Pleeha, Amasaya. Ranjaka Pitta* and *Rakta Dhatvagni* provide mutual help.*Ranjaka Pitta* affects several biological functions, hence the influencing elements are diverse. Hb% and RBC count can indicate *Ranjaka pitta* status, since they correspond with the phases and length of *Raktotpatti* and erytropiosis. The *Ranjaka pitta* function is a transformational concept that promotes haemoglobin synthesis, erythropoiesis, and iron metabolism. Contemporary science supports the Sthanas of *Ranjaka pitta*, including *Amashaya, Yakrit, and Pleeha*.

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