



Review Article

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ROLE OF JATHARAGNI AND RAKTAGNI IN THE PATHOGENESIS OF PERNICIOUS ANAEMIA: A REVIEW

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ABSTRACT

Pernicious anaemia is a megaloblastic anaemia caused by impaired absorption of vitamin B12 due to deficiency of intrinsic factor, leading to defective erythropoiesis. In Ayurveda, this condition can be correlated with Pandu Roga, in which Agni plays a crucial role, where Jatharagni (primary digestive fire) and Dhatwagni (Raktagni) are mainly responsible for the Samprapti (pathogenesis) of Pandu Roga. Acharya Charaka stated that Pandu Roga is primarily associated with the vitiation of Rasavaha Srotas, and according to Acharya Sushruta, Pandu Roga is the disorder of Raktavaha Srotas. In Pandu Roga, due to Jatharagni Mandya, there is abnormal Pachana of Ahara and improper production of Ahararasa, which leads to the formation of Aam, resulting in a deficiency of nutrients that are essential for Rakta Dhatu formation. This impaired digestion leads into defective vitamin B12 absorption. Rasagni and Raktagni are the main Dhatwagni, which are affected in Pandu Roga. Normally, they help in the nourishment and transformation of tissues. Dysfunction of Rasagni and Raktagni leads to improper conversion of Rasa to Rakta, resulting in depletion of blood tissue. This can be correlated with defective erythropoiesis and production of abnormal red blood cells observed in pernicious anaemia. Thus, both Jatharagni and Raktagni Dushti contribute to the pathogenesis of the disease, which leads to deficiency of Vitamin B12 and results in Pernicious anaemia.

Keywords: Pernicious anaemia, Pandu Roga, Rakta Dhatu, Jatharagni, Raktagni.

INTRODUCTION

In Ayurveda, the concept of Agni (metabolic fire) is considered the cornerstone of health and disease. Normal functioning of Agni is essential for longevity of life. The Ayu (age), Varna (colour), Bala (strength), Swastha (health), Utsaha (enthusiasm), Oja (immunity), Teja (energy), and Prana (life) of the human body are only stable when Agni becomes strong ¹. Among the various types of Agni, Jatharagni plays an important role in digestion, and after the formation of Ahararasa, it is divided into two parts, Sarabhaga (useful part) and Kittabhaga (waste part) ². Sarabhaga, which is essential for the further production of Rasadhatu in the body, and Dhatwagni play a pivotal role in the formation of Uttarottar Dhatu (tissue) through the Kshiradadhinyaya ³. Proper functioning of both the Agni ensures the formation of healthy Dhatus (body tissues), while their impairment leads to metabolic disturbances and disease manifestation ⁴.

Due to Agnimandya, Sarabhaga (nutrients that are obtained from food, such as vitamins, minerals, proteins, etc.) are not produced properly. In Pernicious Anaemia, there is impaired absorption of vitamin B12 because vitamins are not absorbed properly.

If Agni is balanced in the body, it helps in the formation of Rakta Dhatu from the Rasa Dhatu. Rakta Dhatu is mostly produced from the Ranjakagni and Raktadhatwagni, which can be correlated with the intrinsic factor in the body, which helps in the absorption of vitamin B12. Pernicious Anaemia is a haematological disorder characterised by impaired absorption of vitamin B12 due to the deficiency of intrinsic factor, resulting in defective erythropoiesis and megaloblastic changes ⁵.

JATHARAGNI

In Ayurveda, Jatharagni is considered the principal Agni because the functioning of all other Agni depends upon it. It is situated in the Grahani (duodenum) and plays a crucial role in the proper Samyaka Pachana (digestion) of Ahara ⁶. Jatharagni is responsible for transforming food into Ahararasa, the primary nutritive essence. This Ahararasa is further separated into Sarabhaga (the useful and nourishing component) and Kittabhaga (the waste component). The nourishing part contributes to the formation of Rasa Dhatu, which supports the body by supplying nutrition and energy.

Types of Jatharagni

Based on Dosha dominance;

1. Samagni (balanced digestive fire): Samagni promotes efficient digestion and supports overall health and well-being.
2. Mandagni (Low digestive fire): Mandagni occurs due to the predominance of Kapha Dosha, leading to sluggish digestive activity. It is characterised by slow digestion, heaviness in the body, and indigestion.
3. Tikshnagni (sharp digestive fire): Tikshnagni develops due to the predominance of Pitta Dosha, resulting in excessively rapid digestion. It is commonly associated with intense hunger and a burning sensation in the body.
4. Vishmagagni (irregular digestive fire): Vishmagagni arises from the predominance of Vata Dosha, leading to irregular and unpredictable digestion. It is often accompanied by symptoms such as gas, bloating, and abdominal discomfort. ⁷

Raktadhatwagni and Ranjakapitta

Raktadhatwagni: Each Dhatu possesses a distinct Dhatwagni that governs the metabolic processes specific to that tissue. For

example, Raktagni is localised within Rakta Dhatu and functions through the Raktavaha Srotas, facilitating the metabolism and sustenance of blood tissue. According to the Kedarkulyanyaya principle from Dhatu Parinama, the nutrients for Raktadhatu are first transported from food to the liver and spleen, where they are processed and transformed by Raktadhatwagni. Both Raktadhatwagni and Rajakapitta play a key role in the formation of Raktadhatu. Raktagni helps in the formation of Sthayi Poshya Rakta, Upadhatu (Sira, Kandara), Mansaposhakansha and also produces Sthula Mala (Pitta) as well as Sukshma Mala^{8,9}.

Ranjakapitta: There are five types of Pitta Dosha and Ranjakapitta is one of them. According to Acharya Sushruta, all the five types of Pitta Dosha are considered Agni-like; Ranjakapitta is known as Ranjakagni¹⁰.

Site of Ranjakapitta According to different Acharya –

- Acharya Sushruta - mainly Yakrut (Liver) and Pleeha (Spleen)¹¹
- Acharya Vagbhata – Aamashaya¹²
- Acharya Sharangdhara – Yakrut
- Acharya Bhavaprakasha – Yakrut and Pleeha

Function: It is mainly responsible for Ranjana (colouring) of the Rasa Dhatu and results in the formation of Rakta Dhatu¹³.

Role of Agni in Pandu Vyadhi

Acharya Vagbhata stated, “Roga Sarve Api Mandaagno”¹⁴, emphasising that all diseases originate from impaired Agni and it is the fundamental cause of most diseases. In Pandu Vyadhi, the intake of Pitta-prakopaka Ahara (Pitta-aggravating dietary factors) leads to the vitiation of Pitta Dosha. The aggravated Pitta impairs Jatharagni, resulting in Agnimandya (diminished digestive capacity). Consequently, Ama is formed, and the production of properly nourished Ahara Rasa is hampered. The resulting Apachita (improperly processed) Ahara Rasa adversely affects the formation of Rakta Dhatu through the mechanism described by Kedarakulya Nyaya¹⁵.

Furthermore, impairment of Dhatwagni, particularly Rasagni and Raktagni, causes dysfunction of Ranjaka Pitta, leading to defective formation and maturation of Rakta Dhatu. This disturbed hematopoietic process ultimately contributes to the pathogenesis of Pandu Vyadhi.

Modern literature review of pernicious anaemia

Pernicious anaemia is a group of disorders characterised by the presence of distinctive morphologic appearances of the developing red cells in the bone marrow. The marrow is usually hypercellular and the anaemia is based on ineffective erythropoiesis. The cause is usually a deficiency of either cobalamin (vitamin B12) or folate; megaloblastic anaemia may occur because of genetic or acquired abnormalities that affect the metabolism of these vitamins or because of defects in DNA synthesis not related to cobalamin or folate.¹⁶

Pernicious anaemia is primarily caused by autoimmune gastritis and other conditions that lead to the destruction of gastric parietal cells. As a result, the production of intrinsic factor is significantly reduced or absent. Since intrinsic factor is essential for the absorption of vitamin B12 in the terminal ileum, its deficiency leads to impaired vitamin B12 absorption. Vitamin B12 is crucial for DNA synthesis, particularly in rapidly dividing cells such as erythroid precursors in the bone marrow. Vitamin B12 deficiency results in ineffective erythropoiesis and the development of megaloblastic anaemia.

Cobalamin (vitamin B12): It exists in a number of different chemical forms. All have a cobalt atom at the centre of a corrin

ring. In nature, the vitamin is mainly in the 2-deoxyadenosyl form, which is located in mitochondria. It is the cofactor for the enzyme L-methyl malonyl coenzyme A (CoA) mutase. The other major natural cobalamin is methyl cobalamin, the form in human plasma and in cell cytoplasm. It is the cofactor for methionine synthase.

Dietary sources and Requirements: Cobalamin is synthesised solely by microorganisms. Ruminants obtain cobalamin from the foregut, but the only source for humans is food of animal origin, for example, meat, fish and dairy products.

Absorption: Two mechanisms exist for cobalamin absorption. One is passive, occurring equally through buccal, duodenal and ileal mucosa; it is rapid but extremely inefficient, with <1% of an oral dose being absorbed by this process. The normal physiologic mechanism is active; it occurs through the ileum and is efficient for small oral doses of cobalamin and it is mediated by gastric intrinsic factor (IF). Dietary cobalamin is released from protein complexes by enzymes in the stomach, duodenum, and jejunum; it combines rapidly with a salivary glycoprotein that belongs to the family of cobalamin-binding proteins known as haptocorrins (HCs). In the intestine, the HC is digested by pancreatic trypsin, and the cobalamin is transferred to IF.

IF is produced in the gastric parietal cells of the fundus and body of the stomach and its secretion parallels that of hydrochloric acid. Normally a vast excess of IF is available. The IF- cobalamin complex passes to the ileum, where IF attaches to a specific receptor (cubilin) on the microvillus membrane of the enterocytes. Cubilin is also present in the yolk sac and renal proximal tubular epithelium. Cubilin appears to traffic by means of amnionless (AMN), an endocytic receptor protein that directs subcellular localisation and endocytosis of cubilin with its ligand IF- cobalamin complex. The cobalamin- IF complex enters the ileal cell, where IF is destroyed. After a delay of about 6 hr, the cobalamin appears in portal blood attached to transcobalamin (TC) II.

DISCUSSION

Jatharagni Mandya leads to impaired digestion and metabolism of food, resulting in the inadequate formation of Ahara Rasa. Consequently, the normal differentiation of Ahara Rasa into Sara Bhaga (nutritive fraction) and Kitta Bhaga (waste fraction) is disturbed due to defective Sara-Kitta Vibhajana. Since Rasa Dhatu is formed from the Sara Bhaga of Ahara Rasa, any qualitative or quantitative impairment in Ahara Rasa adversely affects the formation and nourishment of Rasa Dhatu. From a contemporary perspective, Ahara Rasa provides essential nutrients, including proteins, vitamins, and minerals required for tissue metabolism and haemopoiesis. Among these nutrients, vitamin B12 plays a crucial role in erythropoiesis and haemoglobin synthesis. Therefore, Jatharagni Mandya may lead to inadequate nutrient assimilation, including vitamin B12 deficiency, resulting in impaired erythropoiesis and contributing to the development of Pernicious anaemia.

According to Ayurvedic principles, the formation of Rakta Dhatu depends primarily on two factors: Raktagni and Ranjaka Pitta. Raktagni, the metabolic principle associated with Rakta Dhatu, functions within the Raktavaha Srotas and facilitates the transformation of Rasa Dhatu into Rakta Dhatu through the mechanism described by Kedarkulya Nyaya. Proper functioning of Raktagni is essential for the normal formation, maturation, and nourishment of Rakta Dhatu. Any impairment in Raktagni can disrupt this transformation process, resulting in defective Rakta Dhatu formation. From a contemporary perspective, the liver serves as a major storage site for several nutrients essential for haematopoiesis, including iron, ferritin, and vitamin B12. These

stored nutrients are mobilised and utilised according to the physiological requirements of the body, particularly during blood cell production. Since Raktagni is considered to reside within the Raktavaha Srotas, whose principal sites are Yakrut (liver) and Pleea (spleen), its role in Rakta Dhatu formation may be correlated with the liver's function in storing and regulating nutrients necessary for erythropoiesis. Thus, Raktagni can be conceptually associated with the metabolic processes involved in the storage, mobilisation, and utilisation of haemopoietic nutrients required for the proper formation of Rakta Dhatu.

According to the concept of Dosha–Dushya Dushti, Dhatwagni and Dosha are closely interrelated. When Dhatwagni becomes impaired (Dhatwagni Mandya), the associated Dosha also undergoes vitiation. Consequently, if Rakta Dhatwagni Mandya leads to the abnormal functioning of Ranjaka Pitta. Ranjaka Pitta is a subtype of Pitta Dosha that is responsible for imparting colour to Rasa Dhatu and transforming it into Rakta Dhatu. In pernicious anaemia, vitamin B12 deficiency occurs due to impaired absorption resulting from a lack of intrinsic factor. Intrinsic factor may be correlated with Ranjaka Pitta, as both play an essential role in the formation of Rakta Dhatu (blood). According to Acharya Vagbhata, the seat of Ranjaka Pitta is the Amashaya (stomach). Similarly, intrinsic factor is secreted by the parietal cells of the stomach. This similarity in location provides a basis for correlating Ranjaka Pitta with intrinsic factor. Vitamin B12 binds with intrinsic factor in the stomach and is subsequently absorbed in the small intestine. Following absorption, vitamin B12 contributes to haematopoiesis through its role in DNA synthesis. Similarly, Ranjaka Pitta facilitates the formation of Rakta Dhatu through its Ranjana Karma (the process of imparting colour and transforming Rasa into Rakta). Therefore, from an Ayurvedic perspective, the function of intrinsic factor in supporting vitamin B12 absorption and blood formation can be conceptually compared with the role of Ranjaka Pitta in the production and nourishment of Rakta Dhatu.

CONCLUSION

Agni is the fundamental principle responsible for digestion, metabolism and nourishment of the body, and Dhatwagni governs the proper transformation and utilisation of nutrients at the tissue level. Jatharagni and Dhatwagni are important for the normal functioning of the body. If Agni is imbalanced, then it leads to various diseases. In pernicious anaemia, Agni is imbalanced, and that's why it plays a central role in the pathogenesis of the disease. Pernicious anaemia in Ayurveda is a disorder originating from impairment of Jatharagni and subsequent dysfunction of Dhatwagni, particularly Raktagni. Understanding the disease through the Ayurvedic Framework of Agni provides a holistic perspective and emphasises the importance of Agni restoration, Ama Pachana and proper Dhatu nourishment in both prevention and management of the condition.

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