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Conceptual Review of Yakrit Vikara (Liver Disorders) with special reference to Raktavaha Srotas (Blood Vascular System)

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Introduction: Yakrit is considered, one of the Koshtanga (Visceral organ) and the Moolasthana (Site of forming, controlling, regulating, purifying, reserving, detoxifying, and amalgamating, target) of Raktavaha Srotas. Hence, a Samvaya (Integrated interrelationship) seems to exist between Rakta and Yakrit. The involvement of Pitta in pathology should also be considered as Rakta and Pitta (Asraya) and (Ashrayibhava). Accha Pitta (Bile) is derived from Yakrit. The description of the digestion process mentioned in Ayurveda shows that Yakrit plays an important role in the digestive process. Every Srotas has its own Moolasthana, or root. Chakrapani described the Moolasthana of Srotas as Prabhava Sthana, which signifies the anatomical seat of respective Srotas, the major seat of pathological alterations, and diagnostic value.

Aims and Objectives: To analyse the concept of Yakrit Vikara concerning Raktavaha Srotas.

Materials and Methods: Ayurveda classical textbooks, related books of contemporary science, various journals, publications, articles, etc in support of Yakrit vikara are reviewed and related information is collected and analysed.

Discussion: Yakrit Roga is caused by the vitiation of Rasa and Rakta dhatu. Mandagni and Vishamagni cause the formation of 'Ama' that leads to Srotodushti further causing Vikara (disease/disorder). Dhatu is formed and nourished by the Srotas with the help of Dosha. Srotas are responsible for the formation of new cells and tissues in our body. Tissue results in organ formation. Thus, the paper highlights Yakrit as an organ related to Raktavaha Srotas and various Yakrit Vikara that may manifest due to Raktavaha Srotodushti.

Keywords: Yakrit, Liver Diseases, Rakta, Srotodushti, Ama

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Introduction

The anatomical position of *Yakrit* is mentioned as below and to the right of *Hridaya.*[1] In *Ayurveda, Yakrit* is considered one of the *Koshtanga* and it is a *Matruja Avayava* formed from *Samana Vata, Dehoshma,* and *Rakta.*[2,3,4] In Veda, *Yakrit* is called as *Takima* or *Yakna*. In *Ayurveda*, it is said that *Yakrit Utpatti* is by *Rakta.*[5] It is considered a blood depot. It is mentioned as the *Moola* of *Raktavaha Srotas* and the seat for *Raktadharakala*, *Ranjakagni,* and *Pitta.*[6,7,8] The *Rasa* when reaches *Yakrit*, *Ranjakagni* acts on it. The *Moola* of *Raktavaha Srotas* is considered *Yakrit* and *Pleeha.*[9] *Yakrit* and *Rakta* have *Samavaya* relation. Thus, whenever there is vitiation of *Rakta,* there will be derangement in the function of *Yakrit* and vice versa. The involvement of *Pitta* in this pathology should also be considered as *Rakta* and *Pitta* which bears *Asraya* and *Ashrayibhava Sambandha. Achaa Pitta* is derived from *Yakrit.*[10] In many disease conditions, where *Rakta* involvement is seen, involvement of *Yakrit* is also explained in *Ayurveda*.

Aim and Objectives

To analyze the concept of *Yakrit Vikara in* relation to *Raktavaha Srotas*.

Materials and Methods

Ayurvedic classical textbooks, contemporary scientific literature, various journals, publications, and articles of *Yakrit Vikara* are reviewed and critically analysed and probable inferences are drawn.

Agni & *Yakrit*:[11]

Agni carries out the process of digestion according to *Ayurveda*. *Jatharagni Paka* leads to a breakdown of different proximate components of the food and renders them fit for *Shoshana*/absorption.

Bhutagni Paka processes and converts the nutrients absorbed from *Adhoamashaya* as pre-homologous substances, which are meant finally to be utilized for the *Upachaya*, or building up of the *Sthayidhatu*. *Bhutagni Paka* takes place in the Liver from its anatomical and physiological relation to *Koshta,* indicating the role of *Yakrit* in the production of "*Ama*" and hence produces *Aruchi, Agnimandya*, and *Ajeerna,* etc.

***Raktapitta* & *Yakrit*:[12]**

Both *Rakta* and *Pitta* are mutually vitiated by the disease named *Rakthapitta*. *Dravatwa* and *Ushnatwa* in *Rakta* and *Pitta* will be increased and is mentioned by *Charaka*, that *Yakrit, Pleeha,* and *Raktavahi Sira* are affected while explaining *Raktapitta Chikitsa.*

***Panduroga* & *Yakrit*:[13]**

Pandu Roga has been considered both in *Pittaja* and *Raktaja* diseases. *Pandu* manifests because of *Raktakshaya*. There may be *Sanga* in *Rasavaha srotas*, which inhibits the nourishment of *Rakta Dhatu*. For the formation of *Rakta*, proper functioning of *Rakta Dhatwagni* and *Ranjaka Pitta* is necessary and it takes place at *Yakrit* and *Pleeha*.

***Udararoga* & *Yakrit*:[14]**

In *Udara roga* enlargement of *Yakrit* is one of the causes. *Agnimandya* is the root cause of all *Udara Roga*, the functional derangement of *Yakrit* can be inferred because it takes part in the digestion process. All types of *Udara Roga* mentioned if neglected at the initial stage would turn to *Jalodara*. *Yakritodara* if neglected becomes *Jalodara* along with morphological and functional changes in *Yakrit*.

***Kamala* & *Yakrit*:[15]**

When a person suffers from *Pandu,* intake of more *Pittavardhaka Aahaara* increases *Pitta* excessively, and it starts burning *Rakta* and *Mamsa* leading to *Kamala* due to its *Ushna* and *Ruksha guna. Yakrit* is the root of *Raktavaha Srotas*. It is also evident from investigations that there will be a functional and structural derangement of *Yakrit* in this disease. The symptoms like *Haridra Netra, Twak, Nakha, Anana, Bekhavarna,* and *Daha* are observed in *Kamala.* The second variety of this disease is *Shakhashrita Kamala*. There will be *Sanga* of *Pitta* by *Kapha*, the symptoms mentioned such as *Tilapista Nibha* are similar to obstructive jaundice. The investigations suggest that there will be *Sanga* of *Pitta* in *Yakrit,* which moves to *Shakha* to produce the disease.

***Raktavaha Srotas* & *Yakrit*:[16]**

Chakrapani has described *Moola* as *Prabhava Sthana* of *Srotas*, which means anatomical seat of respective *Srotas* & its function, it is considered as regulatory site of that *Srotas* or main seat of pathology of that *Srotas* or principal seat of manifestation of diseases of that *Srotas*.

Moolsthana of *Srotas* can be determined by *Utpatti Sthana*, *Sangraha Sthana*, and *Vahana Sthana* of that *Dhatu*, based on *Nidana* and *Chikitsha* point of view. The site of origin or the site that regulates these Srotas' functioning is *Srotomoola*. *Acharya Charaka* has mentioned *Yakrit* and *Pliha* as *Moolsthana* of *Raktavaha Srotas* whereas *Acharya Sushruta* has mentioned *Yakrit, Pliha,* and *Raktavahi Dhamani* as *Raktavaha Srotomoola*. During embryonic development origin of *Yakrit* and *Pliha* takes place from *Shonita* (*Rakta)* and after birth, for a particular period production of *Rakta* takes place in *Yakrit* and *Pliha*.

Discussion

Each *Srotas* has a *Srotomula* (root), a *Srotomarga* (passage), and a *Srotomukha* (opening). *Raktavaha srotas* refers to channels involved in blood circulation. *Sushrutokta Raktavaha Srotas*, *Yakrita, Pliha* and *Raktavahinya Dhamnya* are identified as the *Mulasthana.* The human body constitutes a complex network of Srotas, and the effective functioning of these channels contributes to overall health. The liver primarily filters blood obtained from the digestive tract before it circulates to the rest of the body through the heart. Additionally, the liver detoxifies chemicals and metabolizes drugs. In contemporary embryology, the mesoderm generates the septum transversum, which serves as the developmental precursor to the liver. Furthermore, the mesoderm also produces mesenchymal cells, which subsequently differentiate into myoblasts, chondroblasts, lymphoblasts, hemocytoblasts, and other cell types. The blood cells develop from hemocytoblast and lymphoblast. The formation of blood in the foetus in the early stages is under the Yolk sac, from the 3rd to the 5th-month, the formation of blood is under the control of the liver and spleen hence it is called as hepatic phase and later bone marrow takes the function of formation of blood. Red blood cells live only about 120 days because of the wear and tear their plasma membranes undergo as they squeeze through blood capillaries. Without a nucleus and other organelles, RBCs cannot synthesize new components to replace damaged ones. The plasma membrane becomes more fragile with age, and the cells are more likely to burst, especially as they squeeze through narrow channels in the spleen. Ruptured red blood cells are removed from circulation and destroyed by fixed phagocytic macrophages in the spleen and liver, And the breakdown products are recycled. The globin and haem portions of haemoglobin are split apart. Globin is broken down into amino acids, which can be reused to synthesize other proteins. Iron is removed from the haem portion in the form of Fe3, which is associated with the plasma protein transferrin, a transporter for Fe3 in the bloodstream. In muscle fibres, liver cells, and macrophages of the spleen and liver, Fe3 detaches from transferrin and attaches to an iron storage protein called ferritin. Upon release from a storage site or absorption from the gastrointestinal tract, Fe3 attaches to transferrin. The Fe3 transferrin complex is then carried to red bone marrow, where RBC precursor cells take it up through receptor-mediated endocytosis for use in haemoglobin synthesis. Iron is needed for the haem needed for the globin portion. Vitamin B12 is also needed for the synthesis of haemoglobin. Erythropoiesis in red bone marrow results in the production of red blood cells, which enter the circulation. The foetal liver has major hemopoietic function up to the first and second trimesters. In developing embryos, blood formation occurs in aggregates of blood cells in the yolk sac, called blood islands. As development progresses, blood formation occurs in the spleen, liver, and lymph nodes. When bone marrow develops, it eventually assumes the task of forming most of the blood cells for the entire organism. So, *Dushti* of *Mulasthana* i.e., *Yakrita* causes different *Vyadhi* of *Raktavaha Strotas*.

Discussion related to *Agni* and *Yakrit*

Pachaka Agni can be related to the digestive enzymes that play a crucial role in digestion and absorption of nutrients, and the liver is closely related to this process.

Role of the liver in digestion

The liver produces bile a digestive fluid that contains bile salts which emulsifies fat and facilitates their absorption. The bile that is produced in the liver is transported by the bile duct into the gall bladder, where it is stored and concentrated. The liver also helps in regulating Pancreatic enzymes. It produces Cholecystokinin a hormone that stimulates the pancreas to release digestive enzymes thus, the liver and the related Extrahepatic biliary hepatus can be considered as *Pittashaya* and the pancreas as *Agnashaya*. The liver produces the digestive enzyme Amylase that breaks down carbohydrates into simple sugar.

The liver also produces Lipase an enzyme that breaks down fat into fatty acids and glycerol, it also produces enzymes called Proteases that break down Protein into Amino acids, and the bile salts produced by the liver emulsify fat and facilitate their absorption.

Discussion related to Hematoemesis (*Urdhga* & *Adhoga Raktapitta*) and *Yakrit*:

In liver Cirrhosis, there will be scarring and fibrosis of the liver which leads to increased pressure in the portal vein causing blood to flow backward into the oesophagus and stomach leading to Hematoemesis. In liver cancer tumours in the liver can erode into nearby blood vessels causing bleeding and Hematemesis. In portal hypertension high blood pressure in the Portal vein causes regurgitation of venous blood back to the Oesophagus and Stomach through the same veins by which it is drained leading to Hematemesis. In oesophageal varices enlarged veins in the oesophagus rupture and bleed leading to Hematemesis. Liver diseases can impair the production of clotting factors leading to bleeding. Gastrointestinal bleeding is not much related to the Liver. The upper GI bleeding from the Stomach and small intestine causes black tarry stools. The cause for black blood is when the blood gets digested it breaks down into tar-like substances. Taking iron supplements and infections like gastroenteritis, inflammatory bowel disease like Crohn's disease, and ulcerative colitis can cause black stools. As Anorectum is one of the sites of porta caver Anastomosis, due to portal hypertension or Cirrhosis of the liver obstruction of the portal vein may result in regurgitation of venous blood back and causes bleeding from Haemorrhoids, which is blackish red in colour.

Discussion related to *Pandu* and *Yakrit*

Anaemia and liver diseases are closely linked and each can impact on other.

Anaemia causing liver disorders

- **Haemolysis -** Certain types of anaemia like Haemolytic Anaemia can lead to increased red blood cell breakdown resulting in an increase in bilirubin production that can put a strain on the liver.
- **Oxidative stress -** Anaemia lead to oxidative stress which can damage the liver cell and cause anaemia.
- **Impaired erythropoiesis -** Liver disease can impair the production of erythropoietin, a hormone that stimulates red blood RBC production.
- **Haemolysis -** Liver disease can lead to haemolysis which can contribute to Anaemia.
- **Malabsorption -** The liver disease can lead to malabsorption of essential nutrients including iron, vitamin B12, and Folate necessary for red blood cell formation.
- **Inflammation -** Liver disease can lead to chronic inflammation, which can lead to anaemia.
- Patients suffering from Cirrhosis of the liver will have Iron deficiency anaemia and Patients suffering from Autoimmune hepatitis or primary biliary Cirrhosis suffer from Haemolytic Anaemia.

The diagnostic test includes a complete Blood count to evaluate anaemia and blood cell abnormalities. Liver Function test evaluates Liver damage and disfunction. The iron study evaluates the deficiency of Iron. Vitamin B12 and folate levels are evaluated for deficiency. This shows the inter-relationship between the blood vascular system and the Liver.

Discussion related to Liver conditions that can cause Ascites

In Cirrhosis liver scaring leads to increased pressure in the portal vein causing fluid to leak in the peritoneal cavity. In liver cancer tumours in the liver can cause obstruction of blood flow leading to increased pressure and fluid accumulation, the same occurs in liver fibrosis also. In portal hypertension increased pressure in the portal vein causes fluid to leak into the peritoneal cavity. In Hypoalbuminemia, the low levels of albumin in blood can cause fluid to leak out of blood vessels into the peritoneal cavity. Splanchnic vasodilatation in circulation causes increased blood flow and fluid accumulation.

Discussion related to *Kamala* and *Yakrit*

In Jaundice the passage of white or clay-coloured stools is due to a lack of bile pigments, specifically bilirubin being excreted into the intestine. Bilirubin is produced when there is a breakdown of RBC and there is the release of bilirubin which is a yellow pigment into the blood stream.

The liver processes bilirubin converting it into a water-soluble form that can be excreted into the bile. The liver produces bile which is a digestive fluid containing bile salts, bilirubin and other substances. In jaundice there will be often obstruction or blockage in the bile duct, preventing bile from flowing into the intestine. As bilirubin is not excreted into the intestine there is a lack of yellow pigment in the Stools. Thus, the stools lose their natural or normal colour of yellowish brown and will have white and clay colour. These symptoms are seen in Obstructive Jaundice where the bile ducts are blocked by Gall stones, Tumours, Inflammatory structures or even Pancreatitis. In opposition to this in Haemolytic Jaundice, the RBC is broken down and there is release of bilirubin in excess. But as there is no obstruction in a biliary system the stools appear much darker due to the increased amount of bilirubin.

Reasons for Yellowish of skin and Eye in Jaundice

In Jaundice, Skin and Eyes turn yellow due to the accumulation of bilirubin a yellow pigment produced during the breakdown of RBC. Due to obstruction of the bile duct, Bile cannot flow into the intestines resulting in bilirubin build-up. Thus, increased bilirubin accumulates in the bloodstream and tissues and causes yellowish skin and eyes. Conjugated bilirubin is water Soluble and can be excreted into the bile. Whereas Unconjugated bilirubin is not water soluble and can accumulate in the bloodstream and tissues. The skin turns yellow because it binds to protein in the skin and connective tissue called Elastin. The eyes turn yellow because there will be a deposition of Bilirubin on the white part of the eye called Sclera. Because of the accumulation of Bilirubin in urine, the urine will turn a dark yellow colour.

Discussion related to *Raktavaha Srotas* and Liver

Relation between Liver and blood circulatory system- The liver plays a vital role in the blood circulatory system and this system is essential for liver function.

Role of the liver in the blood circulatory system

The liver Filters the Blood and helps in removing toxins bacteria and other foreign substances.

The liver detoxifies the blood breaking down and eliminating toxins. The liver helps in the synthesis of protein essential for blood clotting and transport of nutrients.

It regulates blood sugar levels by storing and releasing glucose to the circulatory system. Vice versa.

Role of the circulatory system in liver function

The circulatory system supplies oxygen to the liver which is essential for metabolic functions. The circulatory system delivers nutrients to the liver which are then processed and distributed to the rest of the body, it removes waste products from the liver which are excreted from the body. It also helps in the regulation of hormones and transport the hormone produced by the liver to other parts of the body. The nutrients that reach venous blood get their red colour from the presence of oxygen-carrying molecules, primarily haemoglobin in RBC. As the liver plays a crucial role in oxygenating the nutrients that reach venous blood that reaches it through the Hepatic portal vein the factors that contribute to or Hepatic artery that supplies oxygenated blood to the liver essential for the Oxygenation of nutrients reach venous blood. The hepatic artery regulates Blood flow to the liver ensuring Oxygenated Blood is delivered to liver cells. Hepatocytes which are made up of cell types of the liver utilise oxygen from the hepatic artery to metabolise nutrients and detoxify harmful substances. This can be taken as the Function of *Ranjaka Agni*. Similarly, the mitochondria present in hepatocytes are responsible for generating energy through oxidative phosphorylation utilising oxygen. (*Ranjaka Agni Karya*). The Cytochrome P450 enzymes found in hepatocytes play a crucial role in metabolizing nutrients and detoxifying harmful substances utilising oxygen from the hepatic artery.

Conclusion

The *Srotas* (Microchannels) can be grouped into physio-anatomical units which perform specified functions in the body and are anatomically identifiable based on their Moola. In Ayurveda *Yakrit* (liver). *Pleeha* (spleen) and *Raktavahi Dhamini* (Large Blood conducting channels) are known as the *Moola* of *Raktavaha Srotas*. The main *Dhatu* which has a relation with *Yakrit* and *Pleeha* is *Rakta.* Most of the diseases of *Yakrit* and *Pleeha* have the pathological involvement of *Rakta Dhatu*.

Yakrit Vikara (Liver disorders) is comprehensively elaborated in Samhita where structural and physiological integrity of the liver is affected. *Raktavaha Srotas* from its *Utpattisthana* we can compare with hemopoietic system. From *Sangrahasthana* liver and spleen are understood as reservoirs of blood. From *Vahanasthana*, it is referred to as circulatory system of body and its *Moolasthana*, with the hepatic portal system. The liver filters toxins and waste from the blood, which helps to maintain the purity and quality of blood. It also helps in the formation and regulation of blood. The liver is the seat for Pitta and an imbalance of Pitta can lead to many diseases. The disease of liver i.e., *Yakrut Vikarjanya Vyadhi* is described in *Raktavaha Strotas* but *Dushti* of *Yakrut* (Pathology of liver) causes *Dushti* of *Raktavaha Strotas* i.e., *Moola Sthana Vikruti* in *Moolasthana* causes damage in the *Srotas*. As described in *Ayurveda Samhita*, it has been found that pathology in liver causes *Raktavahadushti* and vice versa. The *Moola* of *Raktavaha Srotas* is considered as *Yakrit* and *Pleeha, Yakrit* and *Rakta* have integrated interrelationship (*Samavaya)*. The involvement of *Pitta* in this pathology should also be considered, as *Rakta* and *Pitta* bear *Asraya* and *Ashrayibhava Sambandha*. So, any vitiation to *Raktawaha Srotas*, *Rkatadhatu* will lead to *Vikara* which is related to *Yakrit* as well.

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