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YAKRUTOTPATTI: THE AYURVEDIC VIEW OF LIVER FORMATION AND ITS MODERN CORRELATIONS

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ABSTRACT

Ayurveda offers a unique perspective on how the human body and its organs develop. Since the classical texts are brief, it's important to integrate the teachings of different Acharyas with modern scientific explanations. The liver, a key organ for metabolism, is described in Ayurveda as forming from Rakta Dhatu (blood tissue). Similarly, modern anatomy explains that the liver's sinusoids develop due to the large volume of blood from broken vitelline and umbilical veins in the septum transversum. Both blood cells and the liver share a common origin from mesenchymal cells in the mesoderm. This review seeks to explore the parallels between Ayurvedic and modern perspectives on liver development, offering new ways to apply ancient knowledge. Hence, an attempt is made to link the Ayurvedic view of liver formation with modern science.

KEYWORDS: Embryology, liver, Yakrut, Yakrutsharira.

INTRODUCTION

In modern science, visceral organs are studied from two perspectives: anatomical observations and physio-pathological changes. In contrast, Ayurveda simplifies these aspects under the term "Sharir," which covers both anatomical and physiological studies related to specific organs.[1]

Ayurveda explains the fundamental concepts of embryology and organogenesis through principles like Panchamahabhoota, Tridosha, and Saptadhatu. Different combinations of these elements lead to the formation of various organs. The liver, a crucial organ for metabolism, is described by Ayurvedic scholars as originating from Rakta Dhatu (blood tissue). Similarly, in modern anatomy, the liver's sinusoids are said to form from the large amount of blood coming from broken vitelline and umbilical veins in the septum transversum. Furthermore, the same mesenchymal cells from the mesoderm serve as the raw material for both blood cells and the liver.

New diseases, such as liver cirrhosis, liver carcinoma, and hepatitis, have been identified by modern science. Understanding the liver's basic genesis is essential for formulating its pathogenesis and treatment in Ayurveda. This research aims to explore this concept in light of contemporary science, which could aid in treating liver disorders.

AIM

The aim of this study is to evaluate and compare the perspectives of Ayurveda and contemporary science regarding the genesis of the liver.

Review of the Literature

The liver is a well-known organ in Ayurveda. In the Vedas, it is referred to as "Takima" or "Yakna".[2]

Synonyms(Paryaya)

Several synonyms for the liver, such as Kalakhanda[3], Jyotisthana[4], Yakrutkhanda[5], Yakrutpinda[6], Raktadhara, and Raktashaya[7], are found in ancient literature.

- **Kalakhanda**: This term is also used as a synonym for the liver (Yakrut) in the Sushruta Samhita.[3]
- **Jyotisthana**: The word "Jyoti" means Agni (fire). The location of Agni is referred to as Jyotisthana. Fetal nutrition primarily depends on Ahara Rasa, which falls under maternal factors and is controlled by Vayu in Jyotisthana, responsible for cell division. Ahara Rasa is first received by Jyotisthana and then nourishes the body, thus "Jyotisthana" refers to the liver.[4]
- **Yakrutkhanda**: Acharya Vagbhata, in Ashtanga Hrudaya, uses this term in reference to diseases. In modern anatomy, Yakrutkhanda means liver lobes.[5]

- **Raktadhara/Raktashaya**: As the liver is a site for Rakta Dhatu (blood tissue) and stores blood, Ayurveda refers to it as Raktadhara or Raktashaya.[7]

Varna(Color)

Various classical references describe the color of the liver, often linked to signs and symptoms of diseases. For example, the color of Vidradhi is said to resemble the reddish-brown color of the liver.[8] Acharya Vagbhata compares the color of Pittaja Arsha to Shukajihva (parrot's tongue), Yakrutkhanda, and Jalouka.[5] In critical cases of Atisara (diarrhea), Acharya Vagbhata warns that if the stool resembles the color of Yakrutpinda or Mansadhavana, the patient will not survive.[6]

Svarupa (Appearance)

The Bruhadaranyaka Upanishad describes the appearance of the liver and spleen as solid structures, similar to mountains.[4]

Sthana (Site)

The liver is located below and to the right of the heart.[9] Acharya Arundatta supports this statement.[10]

Karya (Physiology of the Liver)

Many Ayurvedic scholars state that the liver’s primary function is to impart red color to Rasa Dhatu (Ranjana of Rasa Dhatu). However, Acharya Vagbhata attributes this function to the stomach (Amashaya).[11] Sushruta explains that Pitta, located in the liver and spleen, provides its characteristic pigment (Ragakrut) to Rasa Dhatu (lymph chyle), a process referred to as Ranjakagni.[12] Acharya Sharangadhara shares a similar view regarding blood formation.[13]

Utpatti (Development)

In terms of body development, Acharya Sushruta and Charaka state in Sharira Sthana that the liver (Yakrut) develops from Matrujabhava (maternal factors).[14] Acharya Sushruta further mentions that Yakrut is also generated from Rakta Dhatu.[16] According to Acharya Arundatta, three Bhavapadarthas—Samana Vayu, Dehoshma, and Rakta Dhatu—are involved in the formation of the liver, spleen, and Kloma.[10] From these descriptions, it is clear that all Acharyas emphasized the significant role of Rakta Dhatu in liver development.

Review of the Modern Literature

Development of Liver and the Bile Duct

The liver starts developing as a hollow endodermal bud from the foregut around the 3rd week of gestation. This bud divides into two parts: hepatic and biliary. The hepatic portion contains bipotential progenitor cells, which differentiate into hepatocytes or ductal cells that form the early primitive bile duct. These rapidly growing cells invade the surrounding mesodermal tissue (septum transversum) and connect with an ingrowing capillary plexus from the vitelline and umbilical veins, which eventually develop into sinusoids.

The biliary portion of the endodermal bud gives rise to the gallbladder and the extrahepatic bile duct. Because of the connection between these growing cell masses and the foregut, bile enters the gastrointestinal tract, beginning to flow around the 12th week of intrauterine life. Hemopoietic cells, Kupffer's cells, and connective tissue cells are derived from the mesoderm of the septum transversum.

The fetal liver performs a significant hemopoietic function during the first and second trimesters. This function diminishes in the final two months of intrauterine life, leaving only a few hemopoietic cells at birth.[17]

DISCUSSION

According to Ayurveda Samhitas, the liver (Yakrut) develops from Rakta Dhatu (blood tissue). In modern science, this is correlated with the development of the liver from the hepatic bud and the septum transversum, which originates from the mesoderm.

Firstly, the mesoderm produces the septum transversum, from which the liver develops. Additionally, the mesoderm produces mesenchymal cells, which give rise to myoblasts, chondroblasts, lymphoblasts, hemocytoblasts[18], etc. Blood cells are formed from hemocytoblasts and lymphoblasts. Thus, the raw material for both the liver and blood is the same—mesoderm.

Secondly, the septum transversum is the initial site where maternal blood is received. The umbilical and vitelline veins open into the septum transversum, making it rich in blood supply.[19] As the hepatic bud grows into the septum transversum, these veins break down, forming the liver sinusoids.[20] This suggests that blood plays a significant role in liver

development. Therefore, Ayurvedic references can be aligned with modern science regarding the formation of Yakrut.

In Ayurveda, Rasa Dhatu, which reaches the liver (Yakrut) and spleen (Pleeha), is believed to be colored by Ranjakagni. However, this concept is challenging to correlate with modern science. In modern terms, this process can be linked to hematopoiesis, which occurs in the liver during intrauterine life. After birth, hematopoiesis shifts to the red bone marrow. However, under certain pathological conditions, the liver may assist in blood cell production alongside the bone marrow. The primary function of the liver in modern science is not to color the chyle but to metabolize fats, proteins, and store vitamins, nutrients, or glycogen. Thus, the Ayurvedic concept of Ranjakagni related to the liver is difficult to match with any known liver functions.

The discussion above indicates that both Ayurveda and modern science recognize the embryological origin of the liver as being associated with blood tissue. Therefore, in the case of liver disorders, treatments targeting blood disorders could be beneficial. This study also opens new possibilities for applying this concept in managing hepatic disorders. The effectiveness of Ayurvedic herbs like Sariva, Manjishtha, and Triphala, which act on the Raktavahasrotasa (blood channels), should be evaluated for treating liver diseases.

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