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Kalas Embryological Aspect with Reference to its Origin

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Abstract: ***Kala sharir is an important part of ayurvedic anatomy. It is a unique subject as well as difficult to understand. Acharya Sushrut was the first to explain Kala in 4th chapter of Shareer sthan named "Garbha Vyakran Shareer". Acahrya Sushruta has defined the Kala as limiting or separating Membranes between Dhatu and Ashaya. These are extremely minute particles and in visible to naked eye, similar to cell. They can be understood by their functions in the body. There are seven Kalas in our body - Mamsdhara, Raktadhara, Medodhara, Shleshmadhara, Pureeshdhara, Pittadhara, Shukradhara kala. [1] Kala can be correlated with Membrane, Fascia, Covering etc. structures as per contemporary science. Membrane may be fibrous, serous and mucous. Membrane are formed during the embryonic period. Here an attempt is made to understand the formation of kala on the basis of Ayurvedic and modern view.***

Keywords: Kala, Kalasharir, Membrane, Epithelium

I. INTRODUCTION

Rachana Sharir (Anatomy) is the branch of Ayurveda which deals with the structure of the body. *Kala Sharir* is a distinct idea of *Ayurvedic Rachana Sharir*. *Kala* are regarded as restricting membranes that exist between *Dhatu* and *Aashay*. In the body, *Kala* perform many functions besides as restricting membranes between two substances like Formation, Protection, Absorption & Secretion. The term "*Kala*" denotes a *Guna* or attribute and describes its physiological component.

Acharya Sushruta defines *Kala* as sheath-like structures encased in *Shleshma* or mucoid substance. They have also been identified as the inner most limiting linings of Dhatu (tissue) and Ashaya (body cavities). *Kala* are known as membranes or layers in current anatomical terminology. Membrane called as a paliable sheet like structure acting as a boundary, lining or partition in an organism. They provide support & protection to the organs. There are many membranes in the body, however *Ayurved* compendia only mentioned seven *Kala*s in the body, therefore the precise idea of *Kala* has to be investigated on this basis. Similarly, while *Sushruta* and other acharyas provided detailed description about *Kala*, its embryological aspect is not extensively developed. *Kala*, like other organs, are significant structures in the body, hence an all-dimensional study is necessary.

A. Aim & Objectives

Exploration of embryological aspect of *Kala Sharir* according to Ayurved and modern perspective.

II. MATERIALS & METHODS

Ayurved compendia, modern textbooks, research papers and articles related to topic were extensively studied.

A. Literary Review

Ayurvedic perspective

Acharya Sushrut was the first who described *Kala*. He defined *Kala* as "*Dhatvashyaantar maryada*" [2] means *Kala* are intervening/limiting structure between *Dhatus* (*Rasa, Rakta*) and their seat *Ashayas* (viscera). He illuminated as when we cut the wood we can see its pith, duramen or core; similarly, we can see the internal *Dhatus* of our body by removing the successive layers or tissues of its flesh. [3]

The formation of *Kala* has been explained by *Acharya Vagbhat* in *Astanga Sangraha* first time. According to *Ashtanga-sangraha*, the moisture *(Kleda)* that stays inside the *Dhatus* (tissues) and *Ashaya* (organs), is cooked (processed) by the heat existing in them (tissues) and creates structures similar to those found in wood (tree) which is called as *Kala*. [4] Because it is made up mostly of the essence of *Dhatus* and a very small amount of *Rasa*, it is known as *Kala*. Other acharyas also have given the almost same explanation regarding the formation of *Kala* which is similar to that of *Astanga Sangraha.*

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A few Ayurvedic literature viewpoints on *Utpatti* of *Kala* are as follows:

1) Ashtanga Sangraha: Very little quantity of *Rasa* & essence of *Dhatus*
2) Ashtanga Hridaya: *Kleda* between *Dhatu* & *Ashaya* [5]
3) Sharangdhar: Moisture present in *Dhatus* [6]
4) Bhavaprakash: *Kleda* inside *Dhatu, Ashaya* and *Dhatvantara* - cooked by heat of body tissues [7]

These *Kala*s are extensively covered with *Snayus* (fibrous tissues), spread as membranous structure like amniotic membrane *(Jarayu)* and smeared with *Shleshma* (mucous). [8] All these three structures may or may not necessarily be present in each *Kala*, even one or two of the above-mentioned structures may be found existing in the *Kala*.

- *Snayu* signifies - structural support
- *Jarayu* signifies - barrier/selective permeability
- *Shleshma* signifies - lubrication and nutrition [9]

B. Modern Perspective

To understand *Kala* in relation to modern anatomy, it would be appropriate to start with the understanding of tissue.

Body Tissue: The human body is made up of many types of tissue. A tissue is a group of cells having similar structure and function. These cells work together as a single unit. Primary types of tissue are as follows:

1) *Epithelial Tissue:* Cells are organised in the epithelium into continuous sheets. They cover body cavities, hollow organs and entire surface of the body. They are major components of the glands.
2) *Connective Tissue:* Adipose tissue, loose connective tissue, and thick connective tissue are all types of connective tissue. Special connective tissues include blood, cartilage, and bone.
3) *Muscular Tissue:* This is of three types viz. Skeletal, cardiac and smooth muscles.
4) *Nervous Tissue:* This tissue consists of neurons, nerve cell processes and cells of neuroglia. [10]

C. Epithelium

The layer that covers the body surfaces is termed as epithelium. Epithelia described in contemporary science have similarity with *Kala* described in *Ayurved*. Embryologically, epithelia are developed from all three germ layers, i.e., ectoderm, endoderm, and mesoderm. Here are a few instances of these:

1) Epithelia from Ectoderm: Epithelium of skin, hair follicles, sweat glands, sebaceous glands and mammary glands. Epithelium over cornea and conjunctiva, external acoustic meatus and outer surface of tympanic membrane. Epithelium of Some parts of the mouth, lower part of anal canal, terminal part of male urethra, parts of female external genitalia.
2) Epithelia from Mesoderm: Tubules of kidneys, ureter, trigone of urinary bladder, uterine tubes, uterus, part of vagina, testis and its duct system, endothelium lining the heart, blood vessels and lymphatics, mesothelium lining the pericardial, peritoneal and pleural cavities and cavities of joints
3) Epithelia from Endoderm: Epithelium of entire gut except part of the mouth and anal canal (lined by ectoderm), auditory tube and middle ear, respiratory tract, epithelium over part of urinary bladder, urethra and vagina.

Epithelium with its underneath connective tissue can be detached as a single layer, which is known as a membrane. If the surface of a membrane is moistened by mucous glands, it is called a mucous membrane or mucosa and when a similar layer is covered by mesothelium is called a serous membrane or serosa.

The mucous membrane lines interior of hollow organs and the body cavities that open outside viz GIT, respiratory, urinary and reproductive systems. Mucus membranes are involved mainly in the functions of various types of secretion and absorption.

Serous membranes: The body cavities that do not open outside are lined by this membrane. Also, the organs lying within such cavities are covered by this. Pleura, pericardium and peritoneum are the examples of serous membranes.

III. DISCUSSION

In general, the term "*Kala*" denotes a little piece, particularly a sixteenth part, of anything, as well as any single part or portion of a total. (Rigveda 7,47,17). This shows that *Kala* are minute structures in the body that play a role according on their location.

All the *Kala* are classified as *Snayu-pratichhanna, Jarayu-santat* and *Shleshma*-veshtit, which correspond to the contemporary names fibrous, serous and mucous membranes, respectively. In case of *Snayu-pratichhanna* the word tendinous sheath is used in certain books. Tendons are fibrous parts of muscles found throughout the body. The *Kala* specified in *Ayurved* is found precisely at the locations mentioned in its categorization. The fibrous membrane is a particular kind of membrane that covers various bodily

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tissues in several places. The deep fascia is a layer of thick, fibrous connective tissue that separates groups of muscles into fascial compartments and covers individual muscles. This fascia is quite similar to the *Mamsadhara Kala* mentioned in Ayurved. As a result, the phrase *Snayu-pratichhanna* used in reference to *Kala* should be interpreted as fibrous membrane.

Similarly in case of *Jarayu-santat*, some writers claim that *Jarayu* is the chorionic membrane, it is actually a component of embryonic life that is descended from the chorion. Chorion takes part in the formation of placenta. Amnion is another tissue which is generated from extraembryonic mesoderm and amniogenic cells. It creates the amniotic membrane that can be associated with Jarayu. As Jarayu is said to be one of the form of *Kala*, it is present in post embryonic life also. Serous membrane is a similar type of membrane that is found in the body and secretes a little amount of fluid to reduce friction. Serous membranes are the internal coverings mostly associated with body cavities. As a result, the name *Jarayu* in *Ayurved* should be associated with the serous membrane rather than the chorionic membrane.

Another kind of *Kala* that is described by practically all *Aacharyas* is *shlemana-veshtita.* Although *Shleshma* is associated to *Kapha*, it is a subtype of *Kapha* that is responsible for lubrication. The *Shleshma*dhara *Kala*, which is referenced in Ayurved and is located in moveable joints, has a primary role of lubricating. The mucous membrane described by modern science is similar to the *Shlemana-veshtita* kind of *Kala* described by *Ayurved* because the functions are mostly similar.

Sushruta's description of the *Aantra Utpatti* can serve as a reference for comprehending *Kala*'s Utpatti. *Aantra* are generated when *Vayu* penetrates the essence of *Rakta* and *Shleshma* during their *Pachan* by *Pitta.* In case of intestine mucous membrane is present between hallow and muscular part. According to the preceding explanation of *Aantra Utpatti*, the essence of *Rakta* may contribute to the production of muscle tissue, while the essence of *Kapha* may contribute to the formation of mucous membrane. Both *Rakta* and *Kapha* have a major liquid quality, that is compatible with the liquid element for the production of *Kala*. Thus, the essence of *Kapha* or its component, as well as some essence from tissue, may play a role in the development of *Kala.*

In contemporary terms, the development of *Kala* can be explained by the production of tissue. In the Material & Method section, information about bodily tissues and their derivatives from diverse epithelia is gathered. The *Kala* mentioned in Ayurvedic literature is similar to the epithelia described in embryology. Previous writers have already compared *Sapta Kala* to contemporary anatomical structures. The following table provides an overview of these structures by comparing them to their embryological development.

Table: Sapta*Kala* and Modern Anatomy Correlation

S.N.	*Kala*	Anatomical Structures	Embryological Derivation
1.	Mamsadhara	Deep fascia, Intermuscular septa	Mesenchyme
2.	Raktadhara	Endothelial lining of the blood vessels and sinuses in the liver & spleen	Endothelium of Mesoderm
3.	Medodhara	Subcutaneous fascia, Omentum, mesentery	Mesothelium of Mesoderm
4.	*Shleshma*dhara	Synovial membrane	Mesothelium of Mesoderm
5.	Pureeshdhara	Mucous membrane of large intestine	Epithelium of Endoderm
6.	Pittadhara	Mucous membrane of stomach & small intestine	Epithelium of Endoderm
7.	Shukradhara	Mucous membrane of testes, semeniferous tubules, Epidedymus, vas deferens	Epithelium of Mesoderm

IV. CONCLUSION

The seven *Ayurvedic Kalas* should be compared to the bodily membranes. The creation of *Kala* is caused by a liquid component that is present between body tissue and the hollow space. The liquid component may be *Kleda*, moisture or essence of *Dhatus.* The main factor in the development of *Kala* is *Kapha* or the essence of *Kapha* and based on the influence of *Vata* and *Pitta*, it is classified as *Snayu-pratichhanna, Jarayu-santat*, and *Shleshma-veshtit*. *Ayurvedic Kala* can be classified as epithelium, mesothelium or endothelium coverings of predominantly mesodermal and endodermal origin.

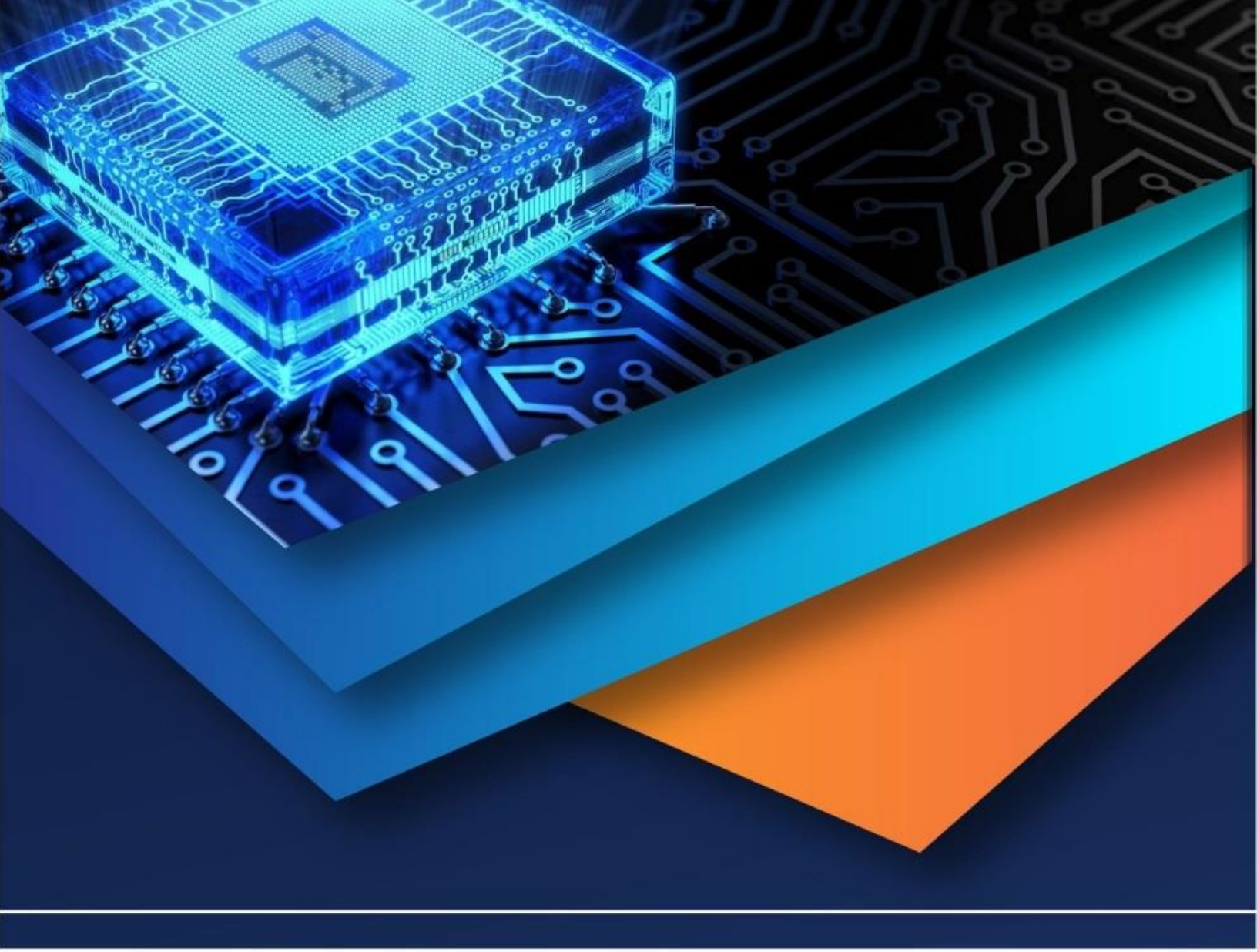
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