ABSTRACT

In Ayurveda, (Kala) has been defined as the internal limiting layer in the (DhatwAshayas.) It can be considered as a membrane or a layer which separates two entities in the body. Seven Kalas are mentioned in this science, of which ( Purishadhara Kala )is the fifth one. It is situated around spleen liver and large intestine(Yakrut, Aantra, Unduka and PakwAshaya.) It is also called as the (Maladharga Kala) Acharya Dalhana has stated that, the ( Purishdhara Kala is Asthidhara) Kala.

As per modern science, the smooth muscle layer of the intestine, contain calcium- sodium ion channels in large number. These channels function mainly as the initiators of smooth muscle contractions in the intestine. This layer can be considered as one of the internal layer of (Purishadhara Kala). The extra cellular fluid is the source of calcium for these ion channels.

Acharya Sushruta has explained the seven stages of poison (i.e Visha Vegas.) and this poison takes the (Ashraya in these Kalas) for exhibiting the symptoms of poisoning.

By this we can correlate ( Purishadhara Kala to Asthidhara Kala,) and also the role of calcium ion channels in the pakwashaya. It explains the (Ashraya-Ashrayee Sambandha of Vata Dosha) and (Asthi Dhatu) in the intestine (PakwAshaya).

Key words: Asthidhara Kala, Ca-Na ion channels of intestine, PakwAshaya, Purishadhara Kala, Vish- Vega

INTRODUCTION

Acharya Sushruta has described (Sapta Kala in Sharir Sthana 2,) an evidence of study of microscopic level. There are seven Kala, situated between (Dhatu and Ashaya.) They define the limits between particular system and their limiting memberene with other systems ( Dhatu and Ashaya.) They are extensively constituted with (Snayu, ) impregnated in( Jarayu) and encased in( Shleshma. ) Study of Kala is important in study of human physiology along with the anatomy. Anatomically it separates different systems ( Dhatu and Ashaya,) where as physiologically it does the( Dharan ) of its respective (Dhatu.) When either of the two functions is disturbed, pathology occurs and, so for the treatment purpose, study of Kala is important.

The function of large intestin is mainly the formation, holding and proper excreion of stool (Purishdhara Kala is Dharan of Purish) for appropriate time. In the intestine the smooth muscle layer consist of Ca-Na ion channels, for gastrointestinal movements. (Dharan of Puris) for appropriate time in the intestine depends upon its motor function. Also the Myenteric or Auerbach’s plexus (nervous control) situated between the longitudinal and circular muscle layer is responsible for the GI movements.

This context involves the study of fifth Kala, the (Purishdhara Kala,) as mentioned by Acharya Sushruta.
Correlation of the interpretation- (−Kala Purishadhara Saa Eva Asthidharal) by Acharya Dalhana, to modern concept of calcium- sodium ion channels in the intestinal layer. Also the Ashraya-(Ashrayee Sambandha of Asthi Dhatu) with (Vata Dosha in the PakwAshaya ) with respect to modern science has been studied in detail.

AIMS AND OBJECTIVES
1) To study Kala,
2) To correlate Asthidhara Kala with Ca-Na ion channel containing layer of the intestine.
3) To study the ( Ashraya- Ashrayee Sambandh of Asthi Dhatu and Vata Dosha, )w.s.r to these channels.

MATERIALS AND METHODS
1) Literatures of Ayurveda, bhrutrayee and laghuutrayee.
2) Modern texts of physiology
3) Research papers and articles from Journals.

REVIEW OF LITERATURE

Kala

Kala is the limiting membrane between different systems (Dhatu and Ashaya. ) Or it can be understood as limiting membrane between two entities of the body(3).

While describing Kala, it is said that as the duramen of cores of a piece of wood or stem becomes exposed to view by cutting into it, so the Dhatus of the body may be seen by removing the successive layers. These Kalas are extensively supplied with Snayus bathed in Jarayu and encased in Shleshma(4). In that sutra, the words ( Pratichhanna, Santata, Vestita) have been used. Though they are different from each other, they indicate the same meaning i.e. Nirmittii (production). (Snayu, Jarayu and Shleshma) are the three basic principles in the formation of Kala.

But at a time all of them are not necessarily required for the formation of Kala. Kala may be formed from emboynic mesoderm ,ectoderm, endoderm ( Snayu, Jaraya and Shleshma )individually or sometimes it may be formed by their combinations. Hence these three are called root cause in the formation of Kala. These three structures i.e. Snayu, Jarayu and Shleshma can be compared with fibre, serous layer and mucous respectively. From above discussion, the nature of Kala becomes clear(5).

Acharya Vagbhata has described the formation of Kala. He said, Kala is formed by the action of respective Agni on particular embryonic layer ( Kleda of Dhatwashaya(6). ) Functions of Kala: Anatomically it separates different systems (Dhatu and Ashaya-“Dhatwashayantarmaryada”). Physiologically it does funtions of the paricular systems (Dharan of that Dhatu )for appropriate time- (−Dharal)

Purishdhara Kala and Asthidhara Kala.

(Purishdhara Kala_is the fifth Kala described by Acharyas in Ayurved. Acharya Sushruta said that, (Malavibhajan ) seperations of nutrients and formation of mala occurs within the gastro intestinal system ( Kostha) which contains large intestine (Pakwashaya.) This Kala is present in the Aantra which is near and around the liver (Yakrut ) and in the Kostha. Unduk) is that place or the organ where Malavibhajan begins As defined earlier, function of Kala is to separate ( Dhatu and Ashaya,) in Pakwashaya )separation of stool and urine also take place because large intestine absorbs water (Dhatus (Purish and Mootra) from its
Ashaya (Pakwashaya) occur because of this (Maladhara Kala). From above statements of Sushruta, it can be understood as (Maladhara) or the (Purishdhara Kala) is situated in large intestine (Pakwashaya), which begins from (Unduk in the Koshta).

(Asthidhara Kala) is not included under the (Sapta Kala) of the Acharyas, but Acharya Dalhana had considered this Asthidharall Kala to be same as Purishdhara Kala.

Here a question arises, that why (Dalhana has considered (Purishdhara Kala as Asthidhara Kala)? Why he has not considered Asthidhara Kala as a separate Kala from (Purishdhara Kala)? An attempt is made to try to solve these questions as,

- (Asthi Dhatu) is the fifth amongst seven Dhatus. As per Acharya Sushruta, Visha Vega are seven because, they take the Ashraya of these seven Kala for appropriate period and exhibits the symptoms accordingly
- In the fifth Vish Vega, there is (Parwabheda,) so when the poison is in its fifth stage, i.e., when it is in the (Purishdhara Kala) it exhibits symptoms related with (Asthi Dhatu.)
- In Ayurveda, Basti is given via rectal route, so this way Basti nourishes the (Asthivaha Srotas) and thereby treats (Vataj Vikaras including Asthi Dhatu Kshaya.)
- In Ayurved, Acharyas Kashyap has explained about the disease (Fakka’) in children. In this disease the child is unable to stand even after completing a year. (Karshya) is the main symptom seen in this disease.
- In modern science Rickets is the disease where there is decreased absorption of calcium and phosphorus from the intestine, leading to bending and softening of the long bones.
- Large intestine contains large number of Ca-Na ion channels, which take up calcium from the extra cellular fluid. From above all discussions, the term (Asthidhara Kala) appropriately suits to (Purishdhara) Kala.

**Calcium- Sodium ion channels of the large intestine**

According to modern view, if we see the nature of Maha Srotas i.e. gastrointestinal tract, it is found to be made up of four layers -Mucous layer, Sub mucous layer, Muscular layer and Serous or fibrous layer.

The nature of (Maha Srota)s i.e. Gastro.Intestinal. tract according to modern view and the nature of Purishdhara Kala described by Sushruta both are similar, Hence (Purishdhara) Kala can be attributed with gastro-intestinal tract.

Smooth muscles in the GI are situated in the muscular layer (longitudinal and circular muscle layer) and also few in the deeper layer of the mucosa. The contractile process in smooth muscle is activated by calcium ion.

- Regulation of Contraction by Calcium Ions
- Combination of Calcium Ions with Calmodulin—Activation of Myosin Kinase and Phosphorylation of the Myosin Head. Calmodulin does this by activating the myosin cross-bridges.

**Importance of Calcium channels**
in generating the smooth muscle action potential

The smooth muscle cell membrane has far more voltage-gated calcium channels than does skeletal muscle but few voltage-
gated sodium channels. Therefore, sodium participates little in the generation of the action potential in most smooth muscle. Instead, flow of calcium ions to the interior of the fiber is mainly responsible for the action potential. Calcium Pump is required to cause smooth muscle relaxation.

- **Source of Calcium Ions** that cause contraction
  1. through the Cell Membrane and
  2. the Sarcoplasmic Reticulum
  3. the extracellular fluid

Almost all the calcium ions that cause contraction enter the smooth muscle cell from the extracellular fluid at the time of the action potential or other stimulus.

**Corelation of Purishdhara Kala with calcium- sodium ion channels containing layer of the intestine**

The Purishdhara Kala is situated in the in large intestine (Pakwashaya,) which starts from the Unduk, i.e, cecum. In gastrointestinal smooth muscle fibers, the channels responsible for the action potentials allow especially large numbers of calcium ions to enter along with smaller numbers of sodium ions and therefore are called calcium-sodium channels.

These channels are much slower to open and close than are the rapid sodium channels of large nerve fibers. The movement of large amounts of calcium ions to the interior of the muscle fiber during the action potential plays a special role in causing the intestinal muscle fibers to contract.

Calcium is a Parthiv (earth) Dravya. It can be considered as one among the Asthi Dhatus. As we have seen there are calcium-sodium ion channels, necessary for the motor functioning of the intestine, these channels does Dharan of Asthi Dhatu for appropriate time so this layer can be correlated to the Asthidhara Kala of the Pakwashaya.

**Correlation of functions of Kala with modern science**

1. It separates the two Dhatus (Purish and Moostra), from the Ashaya (Pakwashaya)

Absorption in the colon - Most of the water and electrolytes in this chyme are absorbed in the colon. Most of the absorption in the large intestine occurs in the proximal one half of the colon, giving this portion the name absorbing colon Bilirubin metabolism (12). Conjugated bilirubin is metabolised by colonic bacteria to form stercobilinogen, which may be further oxidised to stercobilin. Both stercobilinogen and stercobilin are then excreted in the stool.

A small amount of stercobilinogen (4mg/day) is absorbed from bowel, passes through liver and is excreted in the urine, where it is known as urobilinogen or following further oxidation, urobilin

2. Purish Dharan for appropriate time and then is expelled out of the Pakwashaya.

The principal functions of the colon are absorption of water and electrolytes from the chyme to form solid feces and, storage of fecal matter until it can be expelled. The distal colon functions principally for storage of feces until a propitious time for feces excretion and is therefore called the storage colon (11).

(Ashraya-Ashrayee Sambandha of Asthi Dhatu and Vata Dosha )with respect to calcium- sodium ion channels of the intestine.

Acharya Vagbhata has explained the (Ashraya- Ashrayee Sambandh) of (Dhatu and Dosha), in which he say that, Vata Dosha situated in (Asthi Dhatu, Pitta in Sweda) and Rakta, and Kapha in rest of
the (Dhatu) with (Mala and Mootra.)

Inter relationship of (Dhatu and Dosha) – When there is an increase in (Dosha,) changes leads to increase in Dhatus, but about Asthi and Vayu, there is an inverse relation between them. Because (Dosha and Dhatus) are increased by Tarpan. Although Tarpan have property of Kapha Vardhan but it act as (Vata Rashak. Thus vice versa; Langhana) does Kapha Kshaya but instantaneously increases Vata.

**Hypercalcemia Depresses Nervous System and Muscle Activity** - When the level of calcium in the body fluids rises above normal, the nervous system becomes depressed and reflex activities of the central nervous system are sluggish. Also, increased calcium ion concentration decreases the QT interval of the heart and causes lack of appetite and constipation, probably because of depressed contractility of the muscle walls of the gastrointestinal tract. These depressive effects begin to appear when the blood level of calcium rises above about 12 mg/dl, and they can become marked as the calcium level rises above 15 mg/dl (11).

Thus, it is seen that what our Acharyas have said is correct. The depressed contractility of the muscle walls of the gastrointestinal tract can be considered as Vata Kshaya, where as the increased calcium level can be considered as increased Asthi Dhatu. Thus (Ashraya-Ashrayee Sambandha of Asthi Dhatu and Vata Dosha) is correct, with respect to modern science.

**OBSERVATIONS AND DISCUSSIONS**

- Kala is the limiting membrane between (Dhatu and Ashaya. Snayu, Jarayu and Shleshma) are the three basic principles in the formation of Kala.
- Maladhar or the Purishdha Kala is situated in the Pakwashaya, which begins from Unduk in the Kostha. It does the function of Mala Vibhajan,
  - Function of the Purishdha Kala can be compared with-
    - i) Absorptive function of the colon
    - ii) Bilirubin metabolism.
  - The calcium- sodium ion channels, necessary for the motor functioning of the intestine, present in the intestinal layer can be correlated to the Asthidhara Kala of the Pakwashaya.
  - Ashraya-Ashrayee Sambandha of Asthi Dhatu and Vata Dosha in the Pakwashaya can be correlated with respect to calcium- sodium ion channels of the intestine as, Hypercalcemia Depresses Nervous System and Muscle Activity.

**CONCLUSION**

- In the fifth (Vish Vega,) the poison in the body exhibits (Parwahbeda,) which is the symptom related to Asthi Dhatu.
- Calcium- sodium ion channels which are necessary for the motor functioning of the intestine, does Dharan of Asthi Dhatu for appropriate time.
- Functions of (Maladhar Kala can be compared with- Absorptive function of the colon and Bilirubin metabolism.
- (Ashraya-Ashrayee Sambandha of Asthi Dhatu) and (Vata Dosha in the Pakwashaya) is equivalent to hypercalcemia depressing the nervous system and muscle activity.
- (Asthidhara Kala,) is equivalent to the calcium- sodium ion channels containing layer of the colon.
REFERENCES


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