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Concept of *Pittadharakala* and its Modern Perspective

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ABSTRACT: *Ayurveda* is a science of life. In *Vedic* and other ancient literature, the word *"Kala"* has been used in a variety of contexts. *Kala Sharir* is important concept of *Rachana Sharir* which mainly dealt about layers or membranes found in different regions or structures/organ in the body. *Maharshi Sushruta* gave the first description of *Kala*. He described *Kala* as a partition separating *Dhatu* and its *Ashaya*. *Kala* serves as an interface (barrier) between *Dhatu* and *Ashaya* by serving as the *Antar-Maryada* (border) between the two entities. The *Kalas* arrangement supports several *Dhatus*, proving their presence even though they are invisible. Among seven *Kalas*, sixth *Kala* is *Pittadhara Kala*. As per *Acharya Sushruta*, it is situated in between the *Amashaya* (stomach) and *Pakwashaya* (large intestine). The structure lying between these two organs is small intestine. This *Kala* receives four types of food materials namely *Ashita, Khadita, Peeta, Leedha* and facilitates its assimilation, absorption and digestion. Afterword it allows the passage of food material further down into *Pakwashaya* and it is also known as *'Grahani'*. *Pittadhara Kala* is the seat for internal *Agni*, due to *Mandagni* or impairement of *Agni Pittadhara Kala Roga* i.e. *Grahani Roga* occurs *"Roga Sarve Api Mandagno"*. *Kala* is an important concept for both healthy and the diseased person, so one should know the layers of body with respect to normal anatomical and physiological manifestation of disease.

Keywords: Kala, Pittadhara Kala, Grahani, Dhatu, Ashaya, Membrane, small intestine.

INTRODUCTION

Ayurveda is a science of life. In *Vedic* and other ancient literature, the word *"Kala"* has been used in a variety of contexts. *Kala Sharir* is important concept of *RachanaSharir* which mainly dealt about layers or membranes of body. *Maharshi Sushruta* gave the first description of *Kala*. He described *Kala* as a partition separating *Datu* and its *Ashaya*. *Kala* serves as an interface (barrier) between *Dhatu* and *Ashaya* by serving as the *Antara-Maryada* (border) between the two entities. Its existence is inferred by its function; that is of supporting the corresponding *Dhatu*. This is described as comprehensive manner in *Dalhana's* comments. *Rasa*, *Rakta*, and various other *Dhatus* have been utilized for holding and supporting the body. Similar to the manner in which *Vata*, *Pitta*, and *Purisha* support the body in its natural state, they can also be referred to as *Dhatus. Ashayas* are the places where they are located. *Kalas* are the lines of separation between these *Dhatus* along with corresponding *Ashaya* Ghanekar (1998).

The *Kalas* arrangement supports several *Dhatus*, proving their presence even though they are invisible. *Snayu*, for instance, strengthens (the body). *Kalas* encasing mimics an amniotic sac that's enclosing the embryo. They are seven in number mentioned below.

1. Mamsadhara Kala
2. Raktadhara Kala
3. Medodhara Kala
4. Shleshmadhara Kala
5. Purishdhara Kala
6. Pittadhara Kala
7. Shukradhara Kala

Among seven *Kalas*, sixth *Kala* is *Pittadhara Kala*. As per *Acharya Sushruta*, it is situated between *Amashaya* and *Pakwashaya* it is known as *'Grahani'* which supports the four kinds of food pushed out from the *Amashaya* (stomach) and staying in the *Pakwashaya* (large intestine) Shastri (2005).

Aim. To study the basic concept of *Pittadhara Kala* as defined by *Acharya Sushruta* in conjunction with the study of histology of small intestine.

Objectives

1. To study *Pittadhara Kala* according to different *Ayurvedic* texts.
2. To study the small intestine from its anatomico - physiological and histological aspects.

MATERIAL AND METHODS

Literature regarding the various aspects of *Pittadhara Kala* was thoroughly screened from classical texts of *Ayurveda* viz *Brihattrayee* along with their commentaries, online journals. Contemporary literature which can be used to justify its relevance in current scenario was also explored.

Pittadhara Kala. Among seven *Kalas*, the sixth one is *Pittadhara Kala*. *Acharya Dalhana* has said in *Kalpa Sthana, Sarpadansha-visha Adhyaya Pittadhara Kala* as a *Majjadhara Kala* Shastri (2005). In *Uttar-tantra, Acharya Sushruta* has stated it as *Grahani*, the structure where most of the digestion takes place, i.e. in between *Amashaya* (stomach) and *Pakwashaya* (large intestine) Bhishgratna (2018).

Pittadhara Kala receives *Chaturvidha Anna* (*Ashita, Khadita, Peeta, Leedha*) which comes out from the *Amashaya* and holds it till reaches the *Pakwashaya*. *Pittadhara Kala*, considered as the site of *Pachak Pitta* which helps in *Ahara Pachana*. While describing subtypes of *Pitta, Sushruta* has used the word *Agni* e.g. *Pachak Agni*, in spite of *Pachak Pitta* Shastri (2019). *Agni* is the most commonly used synonym for *Pitta* and located in *Grahani* (small intestine) is called as *Jatharagni* Trikamaji (2017).

In *Ayurveda*, digestion, absorption, assimilation and secretion are controlled by *Agni* (*Pachakagni* and *Jatharagni* or *Kayagni*) and it is described that the *Pittasthana* is the *Pachyamanashaya* which is situated in between the *Amashaya* and *Pakwashaya. Pachyamanashaya* is the site where the digested food is re-digested and absorbed. All digestion and absorption take place in *Pachyamanashaya* with the help of *Jatharagni* Dwarkanath (2003). All *Rogas* are produced due to *Mandagni* (impairement of *Agni*) i.e. *"Roga Sarve Api Mandagno"*. (Murthy, 2000) *Pittadhara Kala Roga* i.e. *Grahani Roga* is also mainly caused by *Agni Dushti. Agni Mahabhuta* is predominantly present in *Pitta Dosha* Murthy (1999). *Grahani* and *Agni* both having *Adhara Adheya Sambandha. Jatharagni* rules the process of digestion supported by the three *Doshas*. This ensures with symptomatology like *Atisrushta* and *Vibaddha Mala Pravritti, Jwara, Udgara, Arochaka* etc. Shastri and Chaturvedi (2012). Thus being the site of *Agni*, the *Pittadhara Kala* is related with *Grahani Roga*. So, in this regard, *Pittadhara Kala* has extreme importance. According to modern anatomy, the part of Gastro-intestinal tract between stomach and large intestine is known as small intestine. It is, on average, 23ft long and having three structural parts; duodenum, jejunum and ileum. Functionally, small intestine is chiefly involved in digestion and absorption of nutrients. Small intestine receives indigested food and sends almost digested food into the large intestine Standring (2016).

It receives pancreatic and bile secretions through hepato-pancreatic duct and aid its role or function in the digestion of indigested food Garg (2016).

When food undergo digestion in its partially digested form chyme moving downwards to small intestine from the stomach. Brunner's glands are confined primarily to submucosa of proximal duodenum. It produces class III mucin glycoproteins, it guards against the degradation of this barrier and underlying mucosa by gastric acid, pancreatic enzymes, and other surface active agents associated with this region. Intestinal mucosa secretes enterocrinin, secretin and cholecystokinin, these hormones promote the secretions of succus entericus by stimulating the intestinal glands. Mucosa also stimulates the production and secretion of various digestive enzymes. Several proteolytic, lipolytic and amylolytic enzymes are secreted. Epithelium of small intestine having enterocytes and brush border enzymes, which having absorptive function. Goblet cells secrete mucin, enteroendocrine cells secreted from crypts of Lieberkuhn gland which are found in epithelial lining of small intestine. Paneth cells which secrete protective agents such as defensins and lyzozomes and peyer's patches (only found in ileum) contains mucosal-associated lymphatic tissue (MALT) which house with WBC and lymphocytes. These cells produces antibodies to further protect the small intestine from infection (Chaurasia's 2016). The gut has its own intrinsic neuronal network, the enteric nervous system (ENS), which extends the length of GIT and innervates the mucosal epithelium. ENS regulates gut function and including mucus secretion and renewal.

Small intestine wall has four layers outermost serosa, muscularis, submucosa and innermost mucosa.

1. Serosa: Outermost layer of small intestine, serosa, is a smooth membrane consisting of a thin layer of cells that that secrete serous fluid, comprised of loosely arranged fibroblast and collagen, with the vessels and nerves passing through it.

2. Muscularis: Muscularis is a region of muscles adjacent submucosa membrane. It is responsible for gut movement (peristalsis). It consists of two smooth muscle layers outer longitudinal and inner circular. The myenteric plexus lies between them.

3. Submucosa: The submucosa consist of a layer of connective tissue that contains blood vessels, nerves, and lymphatics.

4. Mucosa: it is the innermost layer of small intestine and is a mucous membrane that secrete digestive enzymes and hormones. Intestinal villi are also the part of this layer. The three sections of the small intestine look similar to each other at a microscopic level, but there are some important differences. The jejunum and ileum do not have Brunner's glands in the submucosa, while the ileum has Peyer's patches in the mucosa, but the duodenum and jejunum do not Guyton and Hall (1996); Tortora and Grabowski (1996).

DISCUSSION

As per the available literature *Kala* serves as an interface (barrier) between *Dhatu* and *Ashaya* by serving as the *Antara-Maryada* (border/ limitation)

between the two entities. The *Kalas* arrangement supports several *Dhatus*, proving their presence even though they are invisible. *Kalas* are seven in number. Among seven *Kala*, sixth *Kala* is *Pittadhara Kala*. As per *Acharya Sushruta*, it is situated between the *Pakwashaya* and *Amashaya* and it is known as *'Grahani'.* It appears that there is difference in the view regarding the position of *Grahani*. *Acharya Charaka* was more concerned with the physiological aspect and *Acharya Sushruta* with anatomical aspect that is why we get elaborate description of anatomical location of *Grahani* in *Sushruta Samhita*. Impairement of *Agni* occurs which leads to *Pittadhara Kala Roga* i.e. *Grahani Roga*. *Grahani Roga* described in classical textbooks of *Ayurveda* represents a group of disorders of digestive system caused by impairement of *Agni*. It is such a disorder, where its significance is emphasized by its inclusion among *Ashtamahagadas*.

To know the exact location of *Pittadhara Kala,* position of *Amashaya* and *Pakwashaya* must be established. *Acharya Sushruta* describes about *Ashayas* as nothing but the potential space for the location of organs (Murthy, 2012). *Ama* means *Apakwa* or undigested, and *Pakwa* means digested (in terms of food). Hence *Amashaya* means the site of partially digested food. According to modern science, digestion is completed in duodenum. So, *Amashaya* can be considered as stomach (site of partially digested food) in the body. *Pakwashaya* means site of fully digested food is present during process of *Pachana*. It is seen in *Antra* i.e. small intestine. According to modern science, digested food is propelled in jejunum and ileum (for absorption), from duodenum (for digestion). So, whole large intestine can be considered as site of fully digested food.

In *Ayurveda* digestion, absorption, assimilation and secretion are controlled by *Agni* (*Pachakagni* and *Jatharagni* or *Kayagni*) and it is described that the *Pittasthana* is the *Pachyamanashaya* which is situated in between the *Amashaya* and *Pakwashaya.* When *Ahara* begins to pass through the *Amashaya* (stomach) to *Pakwashaya* (large intestine), *Pachak Pitta* located in *Grahani* (small intestine) enters and helps in *Ahara Pachana* (digestion). It means *Ahara is* converted into *Ahara Rasa* which is then absorbed by the action *Pittadhara Kala* for the further nourishment of *Dhatus. Pittadhara Kala* is the seat for internal *Agni*, it holds food going on the way to *Pakwashaya* digests, it absorbs useful part and liberates waste part. When it gets spoiled with *Dosha*, it liberates undigested food material.

On contemporary we can understand in this way, the mucosa of small intestine firstly ingests the various types of food taken by oral mucosa, then breaks them into smaller particles for proper digestion. Here various types of enzymatic activity and secretion of digestive juices occurs. Mucosa stimulates the production of mucus and protective agents situated in their special glands. For absorption intestinal villi are there which increases absorptive surface area and special cells produces antibodies for protection from infection or foreign body. Same function is attributed to *Pittadhara Kala* i.e. *Grahana*, *Pachana*, *Shoshana*, *Vivechana* and *Munchana.* So we have to firstly understand the functions of *Pittadhara Kala* in detail.

Grahana means receiving and retention of food in the gastrointestinal tract. It can be understood as collection of food in *Amashaya* i.e. stomach. The stomach is not only digest, but also stores food. It is normally considered as three main anatomical regions: the fundus, the body and the antrum. Gastrinis secreted by the stomach in response to stimulus connected with the ingestion of food products of proteins (*Prana Vayu*) and it stimulates gastric acid secretion (*Pachaka Pitta*). The antrum and pylorus are subject to strong peristaltic waves, and these are thought to have a mechanical effect further disrupting structure as well as mixing stomach contents. Gastric emptying begins shortly after food is ingested and occurs over a period of several hours following a meal Mundt *et al.* (2004). Of all the parts of the stomach, gastric mucosa is found in stomach. This lining is found on inner surface of stomach, along with glands and gastric pits and it is always covered in a layer of thick columnar epithelial (mucus secreting cells) and glandular cells. The epithelial cells of gastric mucosa provide a strong barrier against penetration to protect the stomach against its own secreted acids and pepsin. Gastric mucosa can very easily be exposed to trauma due to focal destruction of mucosal barrier. In addition there are several diseases which cause pathological or inflammatory barrier disruption. Some patients may experience gastric erosion or ulceration i.e. gastric ulcer, peptic ulcer which results in gastric mucosal damage. In this condition the gastric mucosa, body'snatural defense mechanism protects the stomach from harmful acidic environment created by digestive process. A healthy mucosa can greatly decrease the chances of erosion or ulceration in stomach.

Pachana means digestion, this process occurs in small intestine mainly in duodenum. The duodenum is the first approximately 30 cm and shortest segment of the small intestine. It receives partially digested food (known as chyme, moving from acidic environment to a neutral pH) from stomach and plays a vital role in chemical digestion of chyme in preparation for absorption in small intestine. The normal duodenal mucosa is approximately 1mm thick and has numerous fingerlike projections or villi that project above the mucosal surface. In between the villi are crypts (Crypts of Lieberkuhn) that invaginate down into the mucosa. One unique feature of the duodenum is the presence of Brunner's glands. These are found in submucosa and mucus producing. The alkaline mucus helps to neutralize the acidic chyme produced by stomach and produces a suitable pH for digestive enzymes (*Pachaka Pitta*) to work. The activities of the digestive gland are coordinated by both neural and hormonal mechanisms. These regulatory mechanisms are centeredon the duodenum. In celiac disease the normal villous architecture is lost (blunted villli and crypt hyperplasia) and intraepithelial lymphocytes (IELs) are increased.

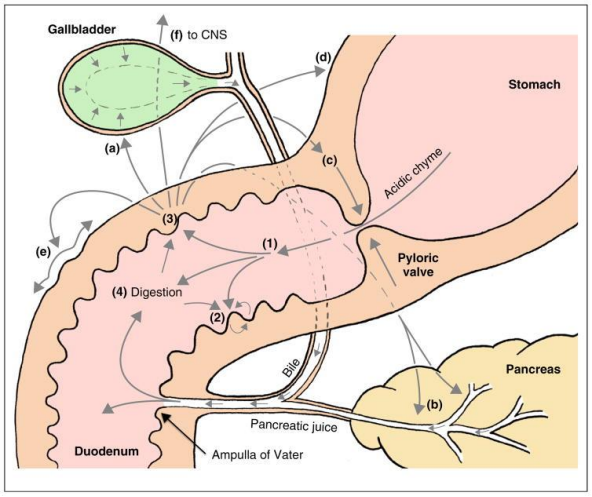

Fig. 1. Stomach i.e. gastric mucosa – parietal cells and chief cell, acidic chyme entering the duodenum (1) evokes local mucosal autocrine and paracrine mechanisms involved in epithelial defense, that is, safe handling and absorption of large amounts of gastric acid (mucous cells & G cells)(2) and stimulates a series of additional actions (3) related to the luminal digestion of nutrients (4) including secretion of bile from gallbladder (a), production and release of pancreatic secretions (b), activation of the 'duodenal brake' that inhibits gastric emptying and acid secretion (c,d), and increases duodenal motility (e). There are also signaling pathways to the brain (f) and CNS Rønnestad *et al.* (2014).

Peristalsis in the small intestine is important for both as a mixing function and as a transport function. Due to contractions and relaxations of muscles, glands present in the inner layer of the small intestine contract and secrete enzymes, juices, and hormones (*Pachaka Pitta* collectively) and release the secretions into the lumen. The ileum and jejunum have the function of being a reactor to allow the digestive enzymes (*Pachaka Pitta*) to do their work, and have a large surface area to allow absorption (*Shoshana*) of the small molecules produced.

Shoshana, for absorption of digested food, a very large surface area is required. This is achieved by greater length of the intestine and presence of circular folds of mucous membrane, villi and microvilli. In fact, the digestive tract is the organ with the largest area facing the 'external' environment, with an absorptive area of approximately 30–35 m^2, of which about 30 m^2 is the surface of the small intestine Helander and Fandriks (2014). Intestinal villi are the finger like projections on the surface of intestinal mucosa. They are large and numerous in the duodenum and jejunum, but are smaller and fewer in the ileum. They increase the surface area of small intestine about eight times. Each villous is covered by a layer of absorptive columnar cells. The surface of these cells has a striated border which is seen, to be made of microvilli. This large area is due to the intensively convoluted surface of the intestines and the structures of villi and microvilli that line the surface, giving an effective 60 to 120 fold enhancement of surface area (for *Shoshana Karma*). From the distal end of the small intestine, the bolus passes to the colon through the ileo-caecal junction. The junction, also known as the ileo-caecal valve, is normally closed and opens to pass digesta through. Its primary function seems to be to prevent regurgitation of colon contents into the ileum, although it does also regulate passage of digesta from the ileum to the caecum.

Vivechana means the separation of *Sara* (useful) and *Kitta* (waste) products from digested food. Water, minerals, etc. are present in the essence of the digested food which gets absorbed and faeces, urine, etc. are expelled from the body. This function of separation is known as *Vivechana*. *Malavibhajana* segregation of *Mala* into *Drava Mala* and *Ghana Mala* takes place at *Pakwashaya*.

Munhana is the expulsion of waste products (removal of faeces and urine from the body).

In short *Grahana* means collection of food, *Pachana* means digestion, *Shoshana* means absorption and assimilation *Vivechana* means separation of *Sara* (useful) and *Kitta* (waste) products, *Munchana* means separation and propelling action, are the functions of *Pittadhara Kala.* It promotes complete digestion, assimilation and absorption. All these functions governed with the help of *Pachakagni* and *Samanvayu* Dwarkanath (2003).

Nariya *et al.* (2013) speculated that *Chinnodbhavadi Kwath* (8.7 ml/kg) showed significant anti-ulcer activity and this activity depends mainly on significant decrease in intensity of gastric ulcers, inhibition of acid secretion and strengthening the mucosal defense system by increasing mucin secretion. The increase in nucleic acid content of gastric wall mucosa in drug treated groups indicate decreased cell shedding and increased life span of cells. He concluded on the basis of data generated that *Chinnodbhavadi Kwath* provides significant protection in experimental gastric ulcer in rats.

Johnson *et al.* (2013) reported gastroprotective activity of *Avipathi Choornam* and the results obtained showed that it is a good and safe therapeutic agent for treatment of ulcer (stomach and duodenal ulcer occurs due to break in the lining of the mucosa of stomach and duodenum).

The above research studies proves that gut mucosa functions such as mucin secretion, protection, host defence response to presence of antigens, microbes and other noxious substances in gut lumen. Such responses are mediated by activation of immune cells in mucosa causing release of chemical mediators that act directly or indirectly on the epithelium. It fight against pathogens in the gut wall, its malfunction will leads to pathology e.g. Stomach and duodenal ulcer, celiac disease and many other inflammatory diseases.

CONCLUSIONS

On the basis of above discussion, it came to conclude that *Kala Sharir* is another key notion that ancient *Acharyas* described in various compendia and human body contains total seven *Kalas*. *Kalas* are the lines of separation between *Dhatus* along with corresponding *Ashayas*. These are more than just limiting or covering membranes; they also serve important functions in the

body's tissues. They serve the organs support and protection. *Pittadhara Kala* is the sixth prime *Kala* in the body. The review of literature of *Amashaya* and *Pakwashaya* & present knowledge of contemporary science indicates that anatomically site of *Pittadhara Kala* is in between the *Amashaya* (stomach) and *Pakwashaya* (large intestine). The structure lying between these two organs is small intestine. This *Kala* receives four types of food materials namely *Ashita*, *Khadita*, *Peeta*, *Leedha* and facilitates its assimilation, absorption and digestion. Afterword it allows the passage of food material further down into *Pakwashaya*.

On functional understanding *Pachaka Pitta* may be correlated with digestive enzymes & juices, this helps in digestion of ingested food. *Grahana* means collection of food, *Pachana* means Digestion, *Shoshan* means absorption and assimilation, *Vivechana* means separation of *Sara* (useful) and *Kitta* (waste) products, *Munchana* means separation and propelling action, are the functions of *Pittadhara Kala.* It promotes complete digestion, assimilation and absorption. All these functions governed with the help of *Pachakagni* and *Samanvayu* at *Pachyamanashaya*. If any disease occurs at this level it causes *Grahani Roga*.

On contemporary it can be understood as mucosal lining situated in between *Amashaya* (stomach) and *Pakwashaya* (large intestine) i.e. small intestine, where digestion of *Anna* (cereals) and absorption of *Annarasa* (nutritional portions) gets accomplished, is the *Pittadhara Kala*.

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