Understanding Grahani as an Anatomical Structure: 
A Correlative Study

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ABSTRACT

The word Grahani inherited from Grahana which means to hold or to retain something. According to Shabdakalpadruma, Grahani is Agnyadhishtana Naadi referring it to a tubular structure. In Samhitas we get references for Grahani as Agni Adhishtana, which is the site for Agni. Grahani also does the Karma of Annagrahana to which Chakrapani comments Grahana means Dharana. Charaka Samhita explains Grahani is situated above Nabhi and it holds Apakwa Anna and eliminates the Pakwa Anna. Susruta and Vagbhata additionally explain Grahani as synonymous to Pittadhara Kala and it extends from Amashaya to Pakwashaya. So, Grahani includes all those anatomical structures wherein Annagrahana, its Shoshana due to Pitta Tejas, Pachana and Vimunchana of Pakwa Anna takes place. The structural and functional involvement of gastro intestinal region in the digestion, absorption, assimilation and excretion of ingested food materials is well understood. This correlative study is an effort to understand the possible anatomical entities and applied anatomy of Grahani as explained by our Acharyas.

Key words: Grahani, Pittadhara Kala, Agni Adhishtana

INTRODUCTION

A healthy person or a Swastha Purusha in Ayurveda is described as one who possesses balanced state of Dosha, Agni, Dhatu and Malakriya along with proper functioning of Indriya and Manas.[1] Out of these factors we can say Agni is the prime most important factor as Agni is the Moola for everything else. Agni or Jatharagni is the building factor of Shareera. In Ayurveda Agni is considered as Praana[2] or Pranasya Adhishtana.[3] All Acharyas have had elaborate explanations regarding Agni and its importance. Acharya Charaka says Agni is the prime responsible factor for all the lively functions of body like Aayu, Varna, Bala, Swasthya, Utsaha, Upachaya and Prabha.[4] He quotes Agni as an indicator for life[5] and Adhishtana for Prana. Acharya Susruta says Agni is one among Dwadasha Pranas.[6] Vagbhata says Agnirakshana[7] is the main principle behind any Chikitsa Karma and also quotes the Moola Karana for all Roga is the imbalanced state of Agni, i.e., Mandagni.[8]

Agni usually is translated as digestive fire or biological fire which is responsible for all the metabolic functions of body. This is said to be located in Grahani according to all Acharyas. Grahani as a word can be understood in 3 different ways, as an anatomical structure, Grahani Dosha and Grahani Roga. While understanding the role of Grahani in Pachanakriya, we take Grahani as an anatomical structure. According to Shabdakalpadruma, Grahani is defined as Agnyadhishtana Nad[9] referring it to a tubular structure. To understand the functional aspects of Grahani, it is essential to know the anatomical features
of it. So, to comprehend it with modern anatomical structures and the role of these structures in the process of digestion, hereby we attempt a comparative study of opinions of different Acharyas on Grahani as Agnyadhistana.

Classical references from Bruhatrayees

Charaka Samhita

Charakacharya explains Grahani in Chikitsasthana 15th chapter: Grahaniidosha Chikitsa. He defines Grahani as Agnyadhistana and further details the functions of it. Grahani does Annagrahana that is retaining the Apakwa Anna and absorption and elimination of Pakwa Anna. It’s said to be located above Nabhi (nabhe: upari) according to him. He also explains the Grahani gets it Upachaya and Apachaya from Agni. From this we can understand the Adhara Adheya Sambandha of Agni to Grahani. Due to this, if Agni Dushiti is present, it leads to Grahani Roga. He further explains about types and treatment of Grahani Roga in this chapter. From the features explained above, Grahani is an anatomical structure where the Dharana of Apakwa Anna is taking place.

Susruta Samhita

Susruta mentions Grahani in Uttaratantra 40th chapter: Atisara Chikitsa. Similar explanations of Charaka can be found here in a different view. He says Grahani is Pittadhara Kala and is situated between Amashaya and Pakwashaya. He opines Bala of Grahani is Agni and this Agni is Grahanayashrita.

Ashtanga Sangraha and Hridaya

Vridha Vagbhata elaborates Grahani as Pittadhara Kala with its Sthana and Karma in Shareera Sthana 5th chapter Angavibhaga Shareeram. He also says Grahani extends from Amashaya to Pakwashaya and does the Karma of Annagrahana, Annasya Shoshana due to Pitta Tejas, Pachana of the Apakwa Anna and Munchana of Pakwa Anna.

Sarvanga Sundari commentary on Ashtanga Hrudaya Shareera Sthana 3/10 again corroborates Grahani as Pittadhara Kala. Here also clear explanation regarding the Annapachana Kriya is available as Karma of Grahani.

Establishing Grahani as an anatomical structure

As seen above, most of the Acharyas considers Grahani as Agni Adhistana. Charaka only mentions Grahani Sthana as Nabhe: Upari and does not give proper elaboration on it. Susruta and Vagbhata say it is from Amashaya to Pakwashaya. From these references we can conclude Grahani can be correlated to the human digestive system and its associated glands. Modern authors of Ayurveda have a say on this with their own views. Acharya Gananath Sen in Prathyaksha Shareera mentions Grahani as “Kshudrantrasya Aadya Bhago Dwodashangula” which means the proximal 12 Angula of Kshudrantra. P.S Varier in Ashtanga Shareeram says Grahani is nothing but pyloric valve. B.G.Ghanekar Tika on Susruta Shareera Sthana details Grahani as the G.I Tract along with digestive glands. This clearly depicts the differences of opinion between recent scholars of Ayurveda.

The basic understanding of Shareera or human body ultimately is to appreciate the Samprapthi of a Anga. This will only be achieved through a mingled apprehension of Rachana-Kriya and Nidana of each Anga. Susruta while explaining each Avayava also mentions its Karma with it. From this we can ascertain that sole explanations regarding the Rachana is not available. So, while contemplating the modern structure of Grahani, we can’t point out a single structure. Hence, we should try and analyse both the functional and anatomical parts together. As we saw, the main Karma of Grahani is Anna Grahanapachana-Vimunchana, hence we can search for the modern counterparts with the same functional criteria. We know the human digestive system is well established in the modern science. We have specific structures for specific functions. Each structure has a unique built according to the function it does.

Modern Anatomical Correlation

Human digestive system is one of the most complex yet wondrous systems in our body. As always said, “We Are What We Eat”, digestive system is the key factor for any living organism’s healthy being. The digestive
system consists of different structures extending from oral cavity to anal canal. Although little digestion takes place in oral cavity, even the human teeth are specially designed to aid in digestion. Proper digestion can be said to initiate from stomach. Partially digested food from stomach reaches duodenum where the maximum amount of absorption takes place. The particles which are not absorbed in duodenum further moves down in the distal parts of small intestine. From then, the food reaches to the large intestine where the process of digestion completes and the end products are separated and eliminated as solid and liquid wastes. Herein let us see the structures for digestion and absorption in detail.

The Stomach

It is the widest part of G.I tract continuing from oesophagus to the duodenum. The stomach lies within the left hypochondrium and epigastrium in a curve when empty and lies far down in the umbilical or suprapubic regions when distended. It functions numerous ways from the initial storage of partially digested food, mechanical breakdown of solid food, conversion of solid food into chyme, passage of the chyme into duodenum and microbial defence. A small degree of digestion of certain elements and protein also takes place in the stomach.[24] The anatomy of stomach is well specialised and unique for all the above functions. The inner surface of stomach possesses a highly thickened and vascular mucosa forming part of the mucosal rosette. The histology when seen thoroughly, have the structures like:

- The mucous membrane
- Submucosa
- Muscularis externa
- Serous layer

The mucuos membrane and the muscularis externa possess some extra features for the smooth functioning of the organ. As seen by naked eyes, there are numerous folds present inside stomach which are called as Gastric rugae.[25] These folds disappear when the stomach is distended. The epithelium bears columnar cells which secretes mucus. This mucus protects the gastric mucosa against acid and enzymes produced during the digestive process. The epithelium also possesses gastric pits.[26] They are indentations in the stomach which denote entrances to tubular shaped gastric glands. Gastric glands are of three types: main gastric glands, cardiac glands and pyloric glands.[27] The main gastric glands are present over most of the stomach, contains important cells lining the glands namely:

- Chief cells - contains pepsinogen which is the precursor of pepsin
- Parietal cells - responsible for production of HCL and intrinsic factor
- Mucus neck cells - secretes mucous which looks chemically dissimilar to the mucous secreted by mucous cells in the surface
- Endocrine cells - produces gastrin

The cardiac and pyloric glands also possess similar cell structure but in a lesser amount.

The stomach functions mainly in 2 ways for the digestive process: the motor function and the storage function.[28]

The motor function

To understand gastric motility, stomach can be functionally divided into 2 parts, the proximal and distal. The proximal part, consisting of fundus and body has minimal motility compared to the distal antral part. Thus, this part serves for storing large amount of solid and liquid products until the initiation of digestion process. The distal part has high rate of motility and functions by:

- Mixing of the food with gastric secretions to form Chyme
- Emptying of the chyme from the stomach to S.I in a very limited and regulated manner so as to avoid the reflux and maintain adequate rate of digestion and absorption.[29]
The storage function

The stomach holds the ingested food for almost 2-4 hours for the digestion process. As long as the food is in stomach, peristaltic constrictor waves, called mixing waves, begin in the mid to upper portions of the stomach wall and move toward the antrum about once every 15 to 20 seconds. As the constrictor waves progress from the body of the stomach into the antrum, they become more intense, some becoming extremely intense and providing powerful peristaltic action potential–driven constrictor rings that force the antral contents under higher and higher pressure toward the pylorus. These constrictor rings also play an important role in mixing the stomach contents. After food in the stomach has become thoroughly mixed with the stomach secretions, the resulting mixture that passes down the gut is called chyme. The appearance of chyme is that of a murky semifluid or paste. This chyme is emptied from stomach to the duodenum for further progression of digestion.[30]

The duodenum

The duodenum is the proximal part of the 5 m long small intestine extending from the pyloric part of stomach, about 25 cms in length. It lies entirely above the umbilicus and is divided into 4 parts based on its run.[31]

Interior of duodenum

The wall of duodenum is typical to the alimentary canal consisting mucosa, submucosa, muscular and serous layer. The serous and muscular layers are similar in anatomy with the stomach whereas the submucosal layer of duodenum possesses Brunner’s glands. The ducts of these glands open into crypts of Lieberkuhn. The secretions of Brunner’s gland contain mucous, bicarbonate ions, and trypsinogen converting enzyme. The mucous membrane also exhibits several special features which help in process of digestion and absorption.[32] They are:

- Presence of valves of Kerkring
- Presence of finger like projections called villi
- Presence of numerous depressions or crypts

The valves of Kerkring are nothing but circular folds of the mucosa which can be seen with naked eye. The presence of these folds helps enlarge the surface area of the intestine to increase the rate of absorption. The intestinal villi are highly vascular projections covering the entire small intestine mucosa. They are abundantly found in duodenum increasing the surface area of the lumen. The epithelial lining covering the villi contains numerous cells performing specialised action on its own like:

- **Enterocytes**: specialised columnar cells responsible for nutrient absorption.
- **Goblet cells**: mucous secreting cells which helps in lubrication of the lumen. It also serves against micro-organism and toxins in the gut lumen.
- **Microfold cells**: follicle associated epithelial cells responsible to take up antigen from intestine and transport it to adjacent lymphoid tissue.[33]

The crypts of Lieberkuhn or intestinal glands are tubular pits that open into lamina propria. There are multiple cells lining the crypts namely enterocytes, mucous cells, paneth cells or zymogen cells, stem cells and neuroendocrine cells.[34]

Process of digestion

The process of digestion and absorption in stomach and small intestine is a combined effect of its structural and functional components. All the nutrients are digested in a specific manner at specific sites with the help of respective digestive enzymes and supportive factors.

In the Stomach

- **Carbohydrates**
  - Fundus of Stomach
  - Mixes up with secretions
  - Hydrolised into Maltose
  - Moved to S.I

- **Protein**
  - Semi digestion with the help of HCl
  - Carried to Duodenum
In the Intestine

**Carbohydrates: Small Intestine**
- Pancreatic amylase

**Disaccharides**
- Disaccharidase

**Monosaccharides**

**Lipids: Small Intestine**
- Pancreatic lipase

**Glycerol, Fatty acids, Monoglycerides**

**Proteins: Small Intestine**
- Trypsin, Chymotrypsin

**Small polypeptides**
- Carboxypeptidase

**Peptide**

**Amino acids**

**Anatomical consideration of absorption**

The process of absorption is poor in stomach as it lacks the microvilli structure present in small intestine. Only a few substances like alcohol is absorbed in the stomach. The specialized anatomical structures of S.I like Folds of Kerkring and intestinal microvilli increase the absorptive area here. These are well developed in the duodenum and jejunum presented circularly. The presence of microvilli over the mucosal surface enhances the absorptive area by another 10 fold. The brush border of microvilli further helps increase the absorptive area by a 20 fold. Thus, the combination of all these structures ultimately results in high absorption rate in the small intestine.

The range of absorption of all the products is tabulated approximately below:

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Range of Absorption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbohydrates</td>
<td>&gt;500gms</td>
</tr>
<tr>
<td>Fats</td>
<td>&gt;100gms</td>
</tr>
<tr>
<td>Proteins (Amino Acids)</td>
<td>50-100gm</td>
</tr>
<tr>
<td>Ions</td>
<td>50-100gms</td>
</tr>
<tr>
<td>Water</td>
<td>7-8 L</td>
</tr>
</tbody>
</table>

In the large intestine, the absorption mainly takes place in the proximal half. The fluids and a portion of ions like sodium and chloride are absorbed in colon before converting it into solid waste. The large intestine has a capacity of absorbing 5-8 litres of fluid and electrolytes per day.

**DISCUSSION**

With this information discussed above, we can highlight and compare the functions and structures of digestive system to that of Grahani. The Grahani as said by Acharyas is located above Nabhi. If Nabhi is taken as a surface landmark here, the stomach and duodenum comes above it. Also, we have seen that Acharya P.S Varier directly correlates Grahani to pyloric valve. On analysis, each function of Grahani is similar to the functions of stomach and duodenum.

The first function of Grahani is said as Agni Adhishtana. Though it cannot be considered as a function, still when we compare, we can say Agni is digestive fire. That is Agni helps in Parinama of Aama Anna to Pakwa. This Agni can be correlated to the various digestive secretions, enzymes or hormones secreted by the stomach and intestine.

The second Karma is Annasya Grahana or Dharana. The undigested food particles are stored in the Grahani for the purpose of Pachana. We have seen the reference from modern school of thoughts that the food is stored in the stomach for about 4 hours before converting it into the chyme with the help of digestive secretions.
In similar way, the Apakwa Anna is held in Grahani and this Anna undergoes Shoshana due to Pitta Tejas that is nothing but the Agni. So, the conversion of food into chyme is a combined action of both the storage and motor functions of stomach. During this process, a certain amount of liquid readily digests in the stomach. This act can be arguably related to Shoshana of Anna.

Next we have the Pachana of Apakwa Anna in Grahani. All the digestion process happening in the stomach and small intestine has been discussed in detail till now. We have seen the breaking down of food into simple particles and the specialised anatomical structures aiding for its absorption. So undoubtedly, we can say the role of Grahani in the process of Anna Pachana here.

Finally, we have the Vivechana and Munchana of Pakwa Anna. Vivechana is the differentiation of food from excreta. Most of this function happens in the large intestine until it is evacuated as solid and liquid human waste.

While discussing Agni, it is equally essential to describe and explain the role of Samana Vata in digestion. Samana Vata is located Sameepa to Agni and performs Annagrahana, Pachana, Vivechana and Munchana. Arunadatta mentions that Samana Vata by its action carries out Agnisandhooshkham thus helping or aiding Agni in Annapachana. [35] Certainly this indicates the supportive action of Samana Vata in the process of Pachanakiaya.

CONCLUSION

Grahani can be considered as an anatomical structure based on its functional aspects. A single structure or organ cannot be pointed out as the counterpart of Grahani, but most functions of Grahani relates it to the stomach and duodenum. The stomach and duodenum fits with the Sthana of Grahani told by Acharyas, that is Nabhe: Upari (above the umbilical region). The structural, positional and functional similarity of stomach and duodenum can be directly correlated to Sthana, Adhishtana and Karma of Grahani.

REFERENCES


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