

ANALYSIS OF THE CONCEPTS OF HUMAN ANATOMY DESCRIBED IN AYURVEDA AND ITS RELEVANCE IN MODERN SCIENCE

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ABSTRACT

The ancient system of Indian medicine *Ayurveda* has described in detail the dissection methodology, nomenclature of human anatomy and clinical anatomy as well. Various classical literature of *Ayurveda* provides the evidence of existence of knowledge of anatomy before the announcement of modern anatomy. Specifically these advances were in the areas of human dissection, embryology, concept of surface anatomy, description of body cavities in term of *Koshtha* and *Koshthangas*, position of various organs, description of sense organs etc. The object of present study is to trace out the most significant and

valuable hidden treasures of anatomy practiced in the past by *Acharya* and its review in modern science.

KEYWORDS: *Acharya*, Dissection, *Koshtha*.

INTRODUCTION

This is a glimpse of history of anatomy according to Grays Anatomy - the anatomical basis of medicine and surgery. But in fact the ancient system of Indian medicine *Ayurveda* has described in detail the dissection methodology, nomenclature of human anatomy and clinical anatomy as well. Various *Vedic* texts, other classical literature of Indian civilization and *Ayurveda* provide the evidence of existence of knowledge of anatomy before the announcement of modern anatomy. Specifically this knowledge was in the areas of human dissection, embryology, concept of surface anatomy, description of body cavities in term of *Koshtha* and *Koshthangas*, position of various organs, description of sense organs etc. Till

date, very little is known to the western world about the profound description of the subject present in ancient texts of Indian medicine. The roots of the modern anatomy lie in history of Indian civilization. The present research work is taken to show eternity of our ancient science.

AIMS AND OBJECTIVES

1. To explore and analyze the text books of *Ayurveda* to find the fundamentals of human anatomy and its relevance in modern science.

MATERIALS AND METHODS

References related to proposed title are collected from classical texts of *Ayurveda* especially *Brihatrayi*. Various publications, internet, books related to the modern anatomy, research papers related to the topic are collected.

Review of literature

Koshtha and *Koshthanga* (Concept regarding body cavities)

Description of *Koshtha*

The body contains *Amashaya*, *agnyashaya*, *pakvashaya*, *mutrashaya*, *unduka* (caecum) and *Raktashaya*, as well as the *Hrudaya* (heart) and the *Phuphphusa* (lungs) are known as *Koshtha*.^[1]

Description of *Koshthanga*

According to *Charaka* - *Koshthanga* (viscera in the thorax and abdomen) are fifteen in number. They are *Nabhi* (umbilicus), *Hrudaya* (heart), *Kloma*, *Yakrut* (liver), *Pliha* (spleen), *Vrukkau* (kidneys), *Basti* (urinary bladder), *Purishadhar* (pelvic colon), *Amashaya* (stomach), *Pakvashaya* (colon), *Uttaraguda* (rectum), *Adharaguda* (anus), *Kshudrantra* (small intestine), *Sthulantra* (large intestine) and *Vapavahana* (omentum).^[2]

According to *Vagbhatta* - *Koshthanga* (organs inside the thorax and abdomen) are the *Hrudaya* (heart), *Phuphphusa* (lungs), *Yakruta* (liver), *Pliha* (spleen), *Unduka* (caecum), two *Vrukka* (kidneys), *Nabhi* (umbilicus), *Dimbha*, *Antra* (intestines) and *Basti* (urinary bladder).^[3]

Description of *Hrudaya* (Heart)

ह-हरति

द-ददाति

य-यच्छति

Harati means it receives the blood through veins from whole body. *Dadati* means gives or distributes blood to whole body through arteries and *Yachhati* means movement.

Hrudaya, similar to *Pundarika* (lotus bud) is facing downwards; it opens when the person is awake and closes when he is asleep.^[4]

The *Hrudaya* is formed from the *Prasad bhag* of the *Rakta* and *Kapha*. The *Hrudaya* is the supporter of the *Prnaavaha* (life carrying) *Dhamani*. Below it, on the left side are the *Pliha* (spleen) and the *Phupphusa* (lung) and on the right side are the *Yakruta* (liver) and *Kloma*. The heart, in particular, is the site of *Chetana* (consciousness) and when this is covered by *Tamas*, all living beings sleep.^[5]

In middle of the thoracic cavity, between the two nipples and at the opening of the *Amashaya* is the *Hrudaya*, which is the site of *Satva*.^[6]

Position of *Basti* (Urinary bladder)

Basti is situated between the *Nabhi* and *Prushtha* in the region of *Kati* and *Vankshana pradesha* and it is closely related with *Mushka* (*Andakosha*), *guda*, *shepha* and it is thin walled and has a single outlet that is directed inferiorly. *Basti* is situated in *Gudasthivivar pradesha* and it is closely related with the *Paurusham*, *Vrushana* and *Guda*. The *Basti* resembles like a gourd and is fixed on all sides by the *Sira* and *Snayu*. This is a site for collection of *Mutra*, a base for the *Mala* and is foremost amongst those organs which sustain life.^[7]

Position of *Yakruta* and *Pliha* (liver and spleen)

Pliha is situated on the left side, becomes enlarged. Similar to the *Pliha*, the *Yakruta* situated in the right side may enlarge which eventually leads to enlargement of abdomen.^[8]

Position of *Amashaya* (Stomach)

Amashaya is situated in between *Nabhi* (umbilicus) and *Stana* (Nipples), where the *Ashita* (eatables), *Khadita* (chewables), *Pita* (drinkables) and *Lidha* (lickables) get digested.^[9]

Concept of *Dhamani* and *Sira* (Artery and vein)

Dhamani (artery) are called so due to pulsation, *Srotas* (channel) due to flowing and *Sira* (vein) due to moving slowly.^[10]

Puncturing the vein should be done in diseases curable by *Raktamokshana* (blood letting), even in other diseases which have not become *Pakva*, also in those diseases not indicated it can be done by practice and after adopting appropriate procedure.^[11]

Description of *Tvacha* (Skin)^[12]

When life is thus induced through the combination of *Shukra* and *Shonita*, it undergoes rapid transformation; the seven layers of *Tvacha* are formed in the same manner as the layers of cream are formed on the surface of boiled milk.

Out of these seven, the first layer from outside is known as *Avabhasini*. This reflects all the colours and the five *Bhutas* are brought into light. The thickness of this layer is one-eighteenth of the *Vrihi* (rice grain). This is the site of the *Sidhma* and *Padma kantaka* (skin diseases).

The second layer is called *Lohita* (reddish layer); its thickness is one-sixteenth of the thickness of the *Vrihi* and this layer is the site of *Tilakalaka*, *nyaccha* and *Vyanga*.

The third layer is called *Shveta* (white layer); it measures one-twelfth of the thickness of rice grain and it is the site of *Charmadala*, *ajagalli* and *Mashaka*.

The fourth layer is known as *Tamra* (pigment layer) which measures one-eighth of the thickness of *Vrihi* and is the site of varieties of *Kilasa* and *Kushtha*.

The fifth layer is called *Vedini* (sensory layer); the thickness of this layer is one-fifth of the thickness of *Vrihi* and it is the site of *Kushtha* and *Visarpa*.

The sixth layer is known as *Rohini* (proliferating layer) and the thickness of this is equal to the thickness of *Vrihi*. It is the site of *Granthi*, *apachi*, *arbuda*, *shlipada* and *Galaganda* diseases.

The seventh layer is called *Mamsadhara* (muscle supporting layer). It has twice the thickness of *Vrihi*. It is the site of *Bhagandar*, *arsh* and *Pidaka*.

The measurements (of the seven layers) of the *Tvacha* described here are found in *Mamsa* (fleshy parts) and not in the forehead or smaller parts like fingers; thus it has been said in connection with the treatment of abdominal diseases that a puncture as deep as a thumb breadth should be made with the help of a trocar and canula.

Description of *Nayana budbuda* (Eyeball)

Nayana budbuda (Eye ball) should be considered as two *Angula* in depth, one's own thumb in width (thickness), two and half *Angula* in circumference; is round resembles the nipple of a cow and arising from all the *Bhutas* (five primary elements-*Pruthvi*, *aap*, *tejas*, *vayu* and *Akasha*) and their properties.^[13] *Mandala*, *sandhi* and *Patala* are present in *Netra* which are respectively five, six and six in numbers.

Description of *Guda* (Anus)

The portion just distal to the *Sthulantra* (large intestine) for four and a half *Angula* is known the *Guda* (anus). There are three *Valaya* at intervals of one and half *Angula* each, known as *Pravahani*, *visarjani* and *Samvarni* and are four *Angula* in diameter. All of them project obliquely for one *Angula*. They are also spiral like conch and are situated one above the other. They have also been described to be of the colour of the palate of an elephant. The anal lips have been described to be one and half *Yava* (barley) from the end of the hair line. Thus the first *Valaya* is one *Angula* above the anal lips.^[14]

Attached to *Sthulantra* is *Guda*, which expels flatus and faeces, its injury leads to quick death.^[15]

Concept of *Mahachidra* or *Bahirmukha srotas* (External opening)

Shravana (ears) two, *Nayana* (eyes) two, *Vadana* (mouth) one, *Ghrana* (nose) two, *Guda* (anus) one and *Medhra* (penis/urethra) one - these are the nine *Bahirmukha srotas* (external orifices) in men; besides these three more (two in the breasts and one of *Raktavaha srotas*) openings are present in women.^[16]

According to *Charaka*

There are nine major orifices - seven in the head and two below.

Description of *Indriya* (Sense organs)

Chakshu (Visual), *Srotra* (auditory), *Ghrana* (olfactory), *Rasana* (gustatory) and *Sparsha* (tactile) are the five *Indriya* (sense organs).^[17]

Akshi (eyes), *Karna* (ears), *Nasika* (nostrils), *Jihva* (tongue) and *Tvacha* (skin) - these five are locations of sense organs.^[18]

Description of *Shira*

Where *Prana* of living being and also all the controlling centres of senses are situated and which is the prime organ is known as *Shira*.^[19]

Description of *Mukha Avayava* (Oral cavity)

Diseases of the mouth are sixty five in total, localised in seven sites; the sites are-lips, roots of teeth, teeth, tongue, palate, throat and the entire mouth.^[20]

DISCUSSION

Koshtha and *Koshthanga* (Concept regarding body cavities)

Kostha, described in *Ayurveda* represents the concept of body cavity of modern science. *Shri Damodar Sharma Gour* said in his book '*Abhinav shariram*' that *Koshtha* is nothing but the body cavities. The body is divided in some cavities like thoracic cavity, abdominal cavity and pelvic cavity. *Koshthangas* are the organs which are present in these body cavities for example *Yakruta*, *pliha*, *amashaya*, *pakvashaya* all these organs are situated in abdominal cavity; *Hrudaya* and *Phuphphusa* are situated in thoracic cavity and *Basti* is situated in pelvic cavity.

Description of *Hrudaya* (Heart)

In *Ayurveda*, the word *Hrudaya* (Heart) itself represents that it performs the function of receiving, distributing and movement. They mentioned *Hrudaya* as the site of consciousness which indicates about its importance, they knew that it is a vital organ of body and if any injury or trauma happens to it, it will definitely leads to death. *Sushruta* mentioned its shape similar to *Pundarika* (lotus bud) facing downwards. If we see heart along with arch of aorta and thoracic aorta, it looks similar to the description mentioned in *Ayurveda* about *Hrudaya*.

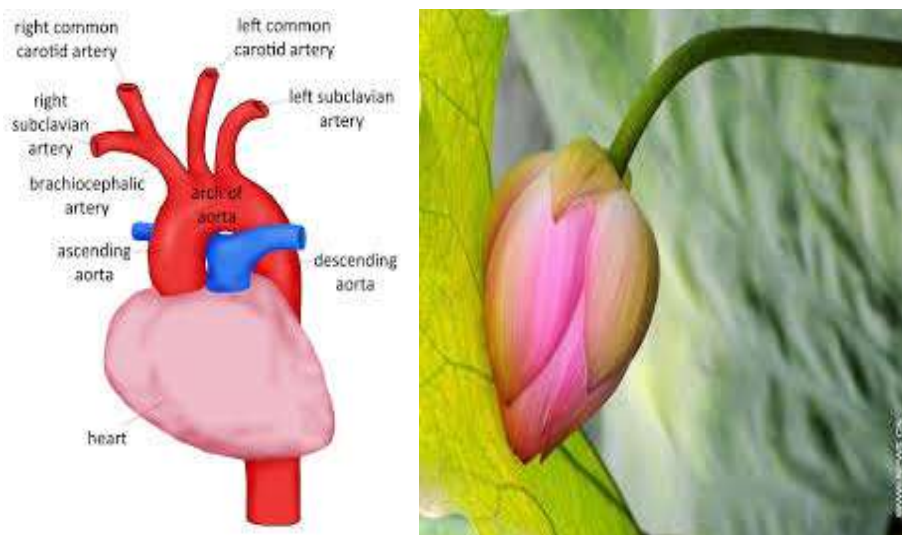


Figure no. 1 Resemblance of Heart with *Pundarik*

Heart is present near the midline of the thoracic cavity between nipples. It is self adjusting suction and pressure pump, the parts of which work in harmony to propel blood to all parts of body. The right side of the heart receives poorly oxygenated (venous) blood from the body through the superior and inferior vena cava and pumps it through the pulmonary trunk and arteries to the lungs. The left side of the heart receives oxygenated blood from the lungs through pulmonary veins and pump it into the aorta for distribution to body.^[21] Below the heart, spleen is present on the left side and liver is present on right side in abdominal cavity. All this description represents that our *Acharya* were well acquainted about the anatomical knowledge of heart.

Position of *Basti* (Urinary bladder)

In our classics it is mentioned that *Basti* has one single outlet directed inferiorly and that is urethra. Besides this the *Basti* resembles like a gourd.

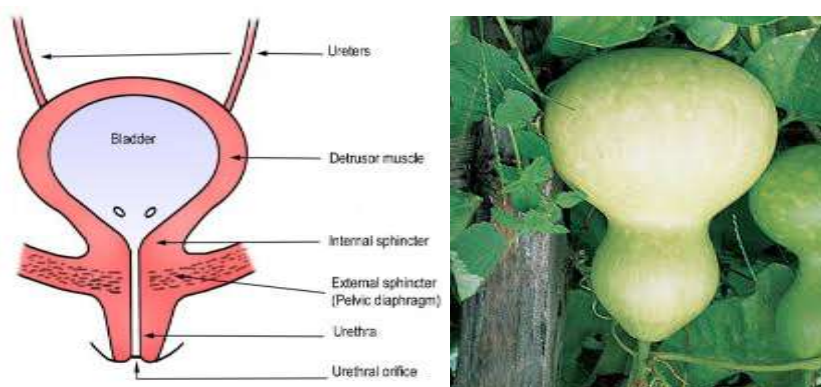


Figure No.2 Resemblance of *Basti* with gourd

Urinary bladder is a hollow muscular organ. It is a temporary reservoir for urine. It is situated in the pelvic cavity. The apex of bladder is connected to umbilicus by median umbilical ligament. When it fills, it reaches posterior to the umbilicus. Its base is separated from the rectum by rectovesical pouch and lower part is separated from the rectum by seminal vesicles and the termination of vas deferens. In males, the neck rests on the base of the prostate gland. In this way it is related to the pelvic organs. It is supported by some true ligaments (condensation of pelvic fascia) and some false ligaments (peritoneal folds).^[22]

All these relations of urinary bladder are similar to the description given about the *Basti* in classics.

Concept of surface anatomy

Surface anatomy (topographic or superficial or visual anatomy) is one of the branches of anatomy. Surface anatomy is a very essential part of clinical anatomy for general and systemic examination of patient. Surface anatomy is the study of the external features of the body. In case of human surface anatomy, these are the forms and proportions of the human body and the surface landmarks which correspond to deeper structures hidden from view. It is the study of deeper parts of the body in relation to the surface of skin. It is helpful in clinical practice and surgical operations. In this, we study surface marking and surface landmarks.

Our *Acharya* have mentioned position of some organs like *Amashaya*, *Hrudaya* etc.; by looking these it can be said that they were also known about the concept of surface marking of organs. For example *Charaka* has mentioned the position of *Amashaya* (stomach) between *Nabhi* (umbilicus) and nipples. In the same way *Vagbhatta* has described the position of *Yakruta* (liver) and *Pliha* (spleen) in right and left flanks respectively. The position of *Hrudaya* (heart) is mentioned between the nipples and in the middle of thoracic cavity.

All this description represents the concept of surface marking in *Ayurveda* many years ago.

Concept of *Dhamani* and *Sira* (Artery and vein)

The concept of artery and veins is described in *Ayurveda* many years ago by name of *Dhamani* and *Sira* respectively.

Ayurveda describes about *Dhamani* that these are called so due to pulsation, it means they know that arteries are blood vessels that carry blood away from the heart to whole body so they requires high speed of blood flow and more pressure to perform this function. Due to

this high blood pressure we can feel its pulsation. About *Sira* it is described that these are so called due to moving slowly. Veins are blood vessels which carry blood towards heart from body and the flow of blood is slow in this.

Sushruta has described that puncturing of *Sira* (veins) should be done in diseases curable by *Raktamokshana* (bloodletting). He did not mention about puncturing of *Dhamani* anywhere in his text. It shows that he knew that arteries are mostly deeply situated in the body and the blood moves with pressure in it so these can't be punctured easily and if punctured blood will come out like fountain in a large area all around the artery.

Description of *Tvacha* (Skin)

Acharya has mentioned seven layers of *Tvacha*. They mentioned that the seven layers of skin are formed in the same manner as the layers of cream are formed on the surface of boiled milk. By this statement it seems that he knew that *Tvacha* covers the external surface of body. Besides this they also mentioned each layer as a site for some specific diseases. They said that the measurements of the skin described are found in fleshy parts and not in the forehead or smaller parts like fingers; it means they knew that the thickness of skin is not same on all over body. Their thickness varies according to region where as on forehead it is very thin and on heels it is very thick.

The skin (also known as the cutaneous membrane or integument) covers the external surface of the body and is the largest organ of the body in both surface area and weight. Structurally the skin consists of two parts. The superficial, thinner portion, which is composed of epithelial tissue, is the epidermis. The deeper, thicker connective tissue portion is the dermis.^[23]

Epidermis – the epidermis is composed of keratinized stratified squamous epithelium. In most regions of the body the epidermis has five strata or layers-stratum basale or germinativum, stratum spinosum, stratum granulosum, stratum lucidum and stratum corneum.

Dermis – the second, deeper part of the skin, the dermis, is composed of a strong connective tissue containing collagen and elastic fibres. Based on its tissue structure, the dermis can be divided into a superficial papillary region and a deeper reticular region.

In whole we can say that there are total seven layers of skin. Those are stratum corneum, stratum lucidum, stratum granulosum, stratum spinosum, stratum basale, papillary layer and the one which is deep is reticular layer. All this information related to skin looks similar in *Ayurveda* while describing the concept of *Tvacha*.

Description of *Nayana budbuda* (eyeball)

In *Ayurveda* the shape of eyeball is mentioned as '*Suvruttam gostanakaram*' means round and resembles the nipple of a cow. They described about *Mandala*, *patala* and *Sandhi* also in context of *Nayana budabuda*. It shows that they knew about the external anatomy of eye and also knew that concentric layers are present in it.

Description of *Guda* (Anus)

Similar to *Ayurveda*, the modern science describes that anus is the terminal part of the large intestine. In *Ayurveda*, three *Guda valaya* are described which can be said as sphincters. Modern science has also mentioned two types of sphincters-internal and external anal sphincters. The external anal sphincter has three parts-subcutaneous, superficial and deep. These parts of external anal sphincter represent the three *Guda valaya* known as *Samvarni*, *visarjani* and *Pravahani* respectively.

Concept of *Mahachidra* or *Bahirmukha srotas* (External opening)

The external openings of body are described in *Ayurveda* under heading of *Bahirmukha srotas* in *Sushruta Samhita* while *Charaka* has mentioned these as *Maha chidra*.

These are two eyes, two openings of nose, one mouth, two ears, one anus and one opening of penis or urethra in males and in females besides these, there are three more openings. These are-one is vagina and two others are of breasts. Our *Acharya* also knew that these openings may be use as routes of drug administration.

Description of *Indriya* (Sense organ)

Humans have a multitude of senses. Sight (ophthalmoception), hearing (audioception), taste (gustatoception), smell (olfacoception) and touch (tactioception) are five senses.^[24] The sites of these senses are eyes, ears, tongue, nose and skin respectively. The description of sense organs is mentioned in *Ayurveda* as *Indriya* and *Indriya adhishtana*.

Description of *Shira*

Ayurveda described about *Shira* that it is the prime organ of the body.

Brain is a very important but delicate organ. There are many centres present in brain which are responsible for such senses as vision, hearing, balance, taste, smell. The function of the brain is to exert centralized control over the other organs of the body. The brain acts on the rest of the body both by generating patterns of muscle activity and by hormones. Brain is the control centre for registering sensations, correlating them with one another and with stored information for making decision and taking actions. It is also the centre for intellect, emotions, behaviour and memory.

By this description we can say that *Acharya* knew that it is the controller of all body activity, behaviour, emotions and senses. So they considered it as *Uttmanga* (prime organ).

Description of *Mukha avayava* (Oral cavity)

The oral cavity is bounded laterally by the cheeks, superiorly by the palate and inferiorly by floor to which the tongue is attached. The structures present in the oral cavity are-lips, teeth, teeth root, palate, tongue and oral cavity proper.

In *Mukha roga nidana*, *Sushruta* has described that the diseases of the mouth are sixty five in total, localised in seven sites; the sites are-lips, roots of teeth, teeth, tongue, palate, throat and the entire mouth. From above mentioned information it can be said that our *Acharya* knew very well about the anatomy of the mouth or oral cavity.

CONCLUSION

Modern science and medicine would be unrecognisable and far more primitive without the immense contribution of the ancient *Acharyas*. The concept of surface marking and its clinical relevance was very well known to *Acharya* as they mentioned position of organs such as *Amashaya*, *hrudaya* etc. *Koshtha* described in *Ayurveda* represents the concept of body cavity of modern science and *Koshthanga* are the organs present in these body cavities. Apart from these our *Acharyas* have given description of sense organs, skin, artery, vein and many more organs very scientifically which shows that our *Acharyas* were very well known about human Anatomy many years before.

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