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 Brihattrayi. 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 Phupphusa (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), Phupphusa (lungs), Yakruta (liver), Pliha (spleen), Unduka (caecum), two Vrukka (kidneys), Nabhi (umbilicus), Dimbha, Antra (intestines) and Basti (urinary bladder).[3]

Description of Hrudaya (Heart)
हृदय
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 _Phuphphusa_ (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)*
*Koshtha*, 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 *Phupphusa* 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*. 
Heart is present near the midline of the thoracic cavity between nipples. It is a self-adjusting suction and pressure pump, the parts of which work in harmony to propel blood to all parts of the 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 pumps it into the aorta for distribution to the body.\[21\] Below the heart, spleen is present on the left side and liver is present on the right side in the abdominal cavity. All this description represents that our Acharya were well acquainted about the anatomical knowledge of the 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.
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
Rak tamokshana (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 adhishthana.

**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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