Journal of Complementary Medicine
And
Alternative Healthcare
ISSN: 2572-1232

Juniper Publishers
key to the Researchers

Review Article
Volume 3 Issue 1 - August 2017
DOI: 10.19080/JCMAH.2017.03.555602

J Complement Med Alt Healthcare

Sympathetic Innervation of Stomach and Spleen: The Role of Coeliac Ganglion in the Chinese Syndromes of Deficiency of Blood and Coldness in Stomach and Spleen as Indications of Pericardium 6

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Submission: July 31, 2017; **Published:** August 07, 2017

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Background

Is it possible to explain the esoteric Chinese syndromes of Empty Blood and Coldness in internal organs as indications of acupoints [1] by modern physiology? We examine the vascular properties of the A.Lienalis, the perivascular innervations of stomach, pancreas, spleen and omentum majus. We focus on vasoconstriction of these internal organs.

Ganglion coeliacum

This ganglion consists of two nuclear compartments enmeshed in a common plexus. The right ganglion contains postganglionic neurons which accompany the hepatic artery. The left ganglion sends its efferents along the terminal arborizations of the splenic artery. We will present in a next issue the special properties of the hepatic artery in the lecture on hepatic artery buffering response (HABR) as presented by W. Lautt in 1981 [1]. This article will focus on the left ganglionic compartment of the coeliac ganglion.

The left coeliac compartment

Postganglionic efferents accompany the splenic artery. This artery runs along the posterior surface of the stomach, lying on top of the pancreatic tail, sends tributaries to the omentum majus and sends several terminal arborizations to the spleen. The fundus of the stomach, the great curvature of the stomach, the tail of the pancreas, repetition dismiss, the large curvature of the stomach, a large portion of the omentum majus, the tail of the pancreas and the entire spleen are irrigated by the splenic artery. The postganglionic afferents of the left coeliac compartment are distributed to the same capillary beds via the terminal arborizations.

Vasoconstrictive action

The postganglionic efferents produce vasoconstriction of the fundus and the great curvature of the stomach. The degree of vasoconstriction is proportional to the number of involved coeliac neurons. The more neurons are involved, the more the terminal arborizations are involved in vasoconstriction. By amplification the vascular trees within the pancreas and spleen will also be involved.

The visceral alerting reflex

Under the heading of defensive responses, the periaqueductal grey (PAG) contains the programmation and coordination of stress situations. These reflexes involve passive- and active responses of respectively freeze and fight-flight archetypes. Somatosensory-, somatomotor-, cutaneous sympathetic - and visceromotor reflexes are coordinated simultaneously. The visceromotor component involves vasoconstriction of visceral vascular beds and vasodilatation of somatomotor vascular beds. The integration by the PAG constitutes the generation of appropriate behavioural responses in stress related adaptation, as described by R.Bandler (Sydney, Australia) as stress coping mechanisms and as revised by R. Dampney [2]. Influence on the PAG through electroacupuncture has been demonstrated by J. Longhurst (Irvine, California) [3] Visceral alert shifts blood for intestinal distribution, acting as a reserve pool, towards the muscular compartment.

Stomach pacemaker

The stomach is characterized by a stomach pacemaker generating slow waves. The fundus accomodates incoming food.

The corpus generates peristaltic waves towards the cardia by action of the pacemaker action of Cajal interstitial cells [4-6]. The antrum generates on the contrary a jet like retropulsion of food [7]. Meanwhile food lumps are emulsified by acid en peptic enzymes.

The pacemaker is situated on the boundary of fundus and corpus. Precisely on the spot where the splenic artery divides tributaries to the fundus, the posterior wall and the great curvature. By amplification of the vasoconstrictive action through the perivascular sympathetic efferents, the stomach is subjected to anterograde dysmotility. The gastroesophageal sphincter region may open, peristalsis is compromized and dominated by the jetlike retropulsion by the antrum.

Nausea and vomiting

Not only a possible toxic content of food, but any adaptive stress response reduces appetite till resolution of the overruling psychological priority. A potential of readiness is generated for activation of the innermost muscular layer in thorax and abdomen. In the thorax the M.transversus thoracis (alias M.trigonalis sterni) lies [8] in continuity with the M.transversus adominis. Both muscles are involved in the vomiting reflex, forming part of the Valsalva manoeuver. Prokinetic drugs are prescribed to remediate nausea and vomiting.

Pericardium 6 (Pc6) (TCM)

Pc6 has been documented to remediate nausea and vomiting. Amongst its multiple indications as compilated by P.Deadman, also the Chinese syndromes of deficiency of Blood of the Stomach, deficiency of Blood of the Spleen and dyspepsia are mentioned. Deficiency of Blood as Chinese concept is explainable by orthosympathetic vasoconstriction. Empty Blood bears no relation to the content of the blood in terms of red blood cell count, hemoglobin, hematocrit etc. We have yet to explain the concept of Coldness in an internal organ.

Caloric content of blood (TCM)

Not only does blood deliver nutrients and oxygen to the tissular target organs, but also heat contained in the blood. The internal organs are warmed up by blood irrigation. During digestion, heat distribution by vasodilatation within stomach and intestines favoures the action of smooth muscles. Vasoconstriction blocks this thermal support. This property of blood to warm up the tissues has been described in Chinese physiology in the first century BC as the syndrome of Coldness of Stomach, Coldness of Spleen or Coldness in these organs combined.

Deficiency heat (TCM)

The heat content of blood that normally should be distributed to stomach, spleen, pancreas, omentum majus and the spleen is diverted by amplified vasoconstriction of the tributaries of the splenic artery. The total arterial capacity of all these organs irrigated by the splenic artery is considerable We.

Heat in the blood (TCM)

Another Chinese concept is surplus Heat in the Blood, defined as deficiency Heat because the caloric content, derived from intestinal vasoconstriction by the visceral alerting reflex, is redistributed. For further study of redistribution of Heat in which the hepatic artery plays a role, we refer to a following article concerning the hepatic artery buffering response (HABR).

Segmental innervation of the coeliac ganglion

The segmental levels innervating the coeliac ganglion are situated in dorsal levels D5-9. The preganglionic neurons are harboured in the intermediolateral column. Five segmental levels account for the sympathetic innervations of stomach, pancreas, omentum majus and spleen.

Adrenergic group A5 in the pons

Descending activation or inhibition is ultimately derived from the id grey amongst other centers. The direct activation of visceral vasoconstriction depends on the noradrenergic collection called A5 in the pons, situated ventrally to the facial nucleus. The A5 descending regulation follows a reticulospinal pathway to the intermediolateral column and the somatomotor anterior horn. They are responsible for the visceral vasoconstriction as demonstrated by P. Guyenet (Virginia, US) [9].

Tracer paradigm

When acupoints are injected with a transsynaptic tracer, the terminal arborization of the secondary neuron is detectable on section with an appropriate dye. In the case of Pc6 the noradrenergic A5 pool is traceable (cf.supra: P.Guyenet). I.Jang (Woosuk, S.Korea) demonstrated tracer presence in PAG and A5, amongst other centers, after injection in Pc6 and He7 [10].

Conclusion

The esoteric syndromes Deficiency of Blood and Coldness in internal organs of Stomach and Spleen are compatable with vasoconstrictive action of postganglionic neurons in the left compartment of the coeliac ganglion. Efferent innervation of vascular beds in the Stomach may induce dysmotility in the pacemaker activity of the Stomach. Preganglionic neurons in the intermediolateral column are under the sympatho-excitatory influence of the noradrenergic reticulospinal group A5 in the pons. Intestinal vasoconstriction forms part of the visceral alerting response in favour of muscular dilatation in behavioural stress coping as organised in the PAG. A transsynaptic tracer injected in Pc6 is detectable in the terminal arborizations of the secondary afferent in direct apposition of the A5 group and the PAG as well. We may conclude that the prokinetic influence of Pc6 is explainable by central inhibition on the efferent segments of the orthosympathetic system via the coeliac ganglion.

In next lectures we will compare three acupoints Pericardium 6 (Pc6), Spleen 6 (Spl6) and Kidney 6 (Ki6). We will discuss common indications and differential symptoms in an integrated manner.

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DOI: 10.19080/JCMAH.2017.02.555602

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