

Neurophysiologic Basis of Back-Shu and Huatuojiaji Points

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Abstract: Acupuncture, a method of traditional Chinese medicine that uses Back-Shu and Huatuojiaji points, is especially effective for treating diseases of the visceral organs. Applying acupuncture on Back-Shu points affects visceral organs in many ways. For example, it dilates the bronchus, affects the heartbeat, stomach motility, urinary bladder contractions and so on. Acupuncture's effects can be explained as viscerocutaneous, cutaneous-visceral, cutaneous-muscular, and visceromuscular reflexes. Segmental dispersion of the sympathetic and parasympathetic systems is related to the location of Back-Shu points. Changes in visceral organs caused by application of acupuncture can be explained as modulation of the sympathetic and parasympathetic systems.

Keywords: Back-Shu Point; Sympathetic and Parasympathetic System.

Introduction

Acupuncture at certain points on the body has been shown to have analgesic and therapeutic effects in the treatment of various diseases (Mayer, 2000; Pintov *et al.*, 1997; Cabioglu and Ergene, 2005; Cabioglu *et al.*, 2006). This therapy has drawn the attention of many investigators and has become the subject of international research. Researches have been conducted on the effect of acupuncture, electroacupuncture, and physical agents and its connections with the central nervous system. The integrity of the peripheral and central nervous systems is necessary for the application of acupuncture. Somatosensory inputs from the skin and/or muscle have been shown to be involved in the control of various autonomic functions (Jansson, 1969; Kehl, 1975; Koizumi *et al.*, 1980).

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In acupuncture application, Back-Shu points are used in the treatment of visceral disease (Lai, 1997; Wang and Zhu, 1996). The autonomic nervous system controls the visceral functions of the body. Acupuncture application is based on the fact that Back-Shu points stimulate related segmental autonomic nerves. In this paper, we describe the relationship between the location of Back-Shu points and the autonomic nervous system.

Back-Shu Points

Specific points on the back are called the Back-Shu points. These are the points related to the Urinary Bladder Channel located at the back 1.5 cun lateral to the Du channel. Each of these Back-Shu points relates to an internal organ and the point's location is in approximately the same horizontal plane as its related organs. For example, the Back-Shu point of the kidney is at the same level on the back as the kidneys themselves (O'connor and Bensky, 1988). Applying acupuncture on Back-Shu points affects visceral organs in many ways, for example, dilatation of the bronchus, changes heart beat, stomach and intestinal motility, stomach acid levels, release of pancreatic secretions, visceral vessel dilatation, and urinary bladder contractions (Sovijarvi and Poppius, 1977; Zhang, 2006; Cheng, 1987).

Back-Shu points are important not only in the treatment of diseases of the internal organs, but they also have clinical significance in the diagnosis of visceral organ disorders. When any of the visceral organs malfunctions, positive reactions such as sensitivity or tenderness will be manifested at the corresponding Back-Shu points. Palpation of sensitive points can be a useful aid to diagnosis. Stimulating techniques such as acupuncture, moxibustion, or massage may be applied to these points to relieve disorders of the corresponding organs (O'connor and Bensky, 1988; Teitelbaum, 2000).

The importance of Back-Shu points in the treatment cannot be overemphasized; however, in light of new research on this subject, interest in Back-Shu points has increased. Back-Shu points can be used in acute and chronic conditions. They are particularly important in treating chronic diseases and, indeed, one may go so far as to say that a chronic disease cannot be treated without using these points (O'connor and Bensky, 1988; Teitelbaum, 2000).

Huatuo-Jiaji Points

Huatuo-Jiaji is a group of 34 points on both sides of the spinal column, 0.5 cun lateral to the lower border of each spinous process, from the first thoracic vertebra to the fifth lumbar vertebra. Huatuo-Jiaji points can be used to treat various disorders including those of the cardiovascular, digestive, urinary, and reproductive systems.

Each Back-Shu point elicits the same treatment effects as the corresponding Jiaji point (Table 1). However, perpendicular needle insertion into Back-Shu points is dangerous, and superficial needling may not attain the best effect. Therefore, Jiaji points are the best substitutes for Back-Shu points.

Table 1. Back-Shu Points and Their Corresponding Huatuo-Jiaji Points

Organs	Back-Shu Points	Huatuo-Jiaji Points Levels
Lung	UB 13	T 3
Pericardium	UB 14	T 4
Heart	UB 15	T 5
Liver	UB 18	T 9
Gallbladder	UB 19	T 10
Spleen	UB 20	T 11
Stomach	UB 21	T 12

Segmental Distribution of the Sympathetic and Parasympathetic Nervous Systems

The portion of the nervous system that controls the visceral functions of the body is called the *autonomic nervous system*. This system helps control arterial pressure, gastrointestinal motility, gastric acid secretion, cardiac heart rate, urinary bladder emptying, sweating, body temperature, and metabolic functions. Efferent autonomic signals are transmitted through major subdivisions called the sympathetic and parasympathetic systems (Bear *et al.*, 2007).

Sympathetic nerves take their source from the T 1 and L 3 segments of spinal cord, first to the sympathetic chain, then to the organs and tissues controlled by the sympathetic nerves. Some preganglionic nerves, which pass through the paravertebral ganglion chain, end at the postganglionic neurons of the collateral ganglions near the visceral organs. From these ganglions, postganglionic axons are distributed to the visceral organs (Bear *et al.*, 2007; Guyton and Hall, 2001; Williams *et al.*, 1999; FitzGerald and Folan-Curran, 2002).

The primary parasympathetic neurons are situated at the cranial nervous nucleus and sacral 2 to 4 nuclei (Bear *et al.*, 2007; Guyton and Hall, 2001).

Correlation of the Autonomic Nervous System and the Back-Shu Points

There is a relationship between the Back-Shu points and the distribution of segmental neurons of the spinal cord. In Chinese medicine, parallel to this approach, the Back-Shu points are used to affect visceral function. Anatomic examination of Back-Shu points reveals that each is located at a vertebral level consistent with sympathetic and parasympathetic outputs to an associated organ except for the small and large intestines, which is located at the first sacral segment and the fourth lumbal segment, respectively.

The sympathetic neurons that innervate the lungs are located at the level of T 1 through T 4, also UB 13 of the Back-Shu point of the lungs is situated at the level of the third thoracic vertebra. The sympathetic neurons that innervate the pericardium are located at the level of T 1 through T 5, also UB 14 of the Back-Shu point of the pericardium is situated at the level of the fourth thoracic vertebra. The sympathetic neurons that innervate the heart are located at the level of T 1 through T 5, also UB 15 of the Back-Shu point of the heart is situated at the level of the fifth thoracic vertebra. The sympathetic neurons that innervate the liver are located at the level of T 8 through T 11, also UB 18 of the Back-Shu point

Table 2. Sympathetic and Parasympathetic Innervations of Organs, Back-Shu Points and Dermatome

Organ	Back-Shu Point	Dermatome	Segments of the Autonomic Fibers
Lung	UB 13	T 2-4	T 1-4 sympathetic
Pericardium	UB 14	T 4	T 1-5 sympathetic
Heart	UB 15	T 5	T 1-5 sympathetic
Liver	UB 18	T 9	T 8-11 sympathetic
Gallbladder	UB 19	T 10	T 8-11 sympathetic
Spleen	UB 20	T 11	T 8-11 sympathetic
Stomach	UB 18	T 4-L 1	T 5-12 sympathetic
Kidney	UB 23	L 2	T 10-L 2 sympathetic
Large intestinal	UB 25	L 4	T 8-L 4 (take branch from at the level of L 4)
Small intestinal	UB 27	S 1	S 2-4 vagus parasympathetic
Urinary bladder	UB 28	S 2	S 2-4 parasympathetic

of the liver is situated at the level of the ninth thoracic vertebra. The sympathetic neurons that innervate the gall bladder are located at the level of T 8 through T 11, also UB 19 of the Back-Shu point of the gall bladder is situated at the level of the tenth thoracic vertebra. The sympathetic neurons that innervate the spleen are located at the level of T 8 through T 11, also UB 20 of the Back-Shu point of the spleen is situated at the level of the eleventh thoracic vertebra. The sympathetic neurons that innervate the stomach are located at the level of T 5 through T 12, also UB 21 of the Back-Shu point of the stomach is situated at the level of the twelfth thoracic vertebra. The sympathetic neurons that innervate the kidney are located at the level of T 10 through L 2, also UB 23 of the Back-Shu point of the kidney is situated at the level of the second lumbal vertebra. The neurons that innervate the large intestine are located at the level of T 8 through L 2 (take branch from at the level of L 4), also UB 25 of the Back-Shu point of the large intestine is situated at the level of the fourth lumbal vertebra. The neurons that innervate the small intestine are located at the level of T 5 through T 12, also UB 27 of the Back-Shu point of the small intestine is situated at the level of the 1 sacrum foramen. The parasympathetic neurons that innervate the urinary bladder are located at the level of sacral 2, also UB 28 of the Back-Shu point of the urinary bladder is situated at the level of the 2 sacrum foramen (Table 2) (Tortora, 1986; Keith, 1992; Snell, 1992; Gray, 1995).

Viscero-Cutaneous Reflex

According to viscero-cutaneous reflex, a functional or organic disease of the viscera causes pain, hypalgesia, tension, or irritation to a particular area of the skin. As a general rule, the skin area where pain is projected has, in relation to the painful viscera, common somatic origins as to the embryo and consequently, it is innervated in a sensory way from the same neurotome of the spinal cord. The skin and related viscera have the same segmental innervations, usually by dorsal roots, spinal nerves, and nuclei (referred pain resulting from reflex phenomena). Nociceptive impulses from the affected viscera pass to the dorsal horn and then to the anterior horn of spinal cord across interneurons. It is interesting to

note that nociceptor axons from the viscera enter the spinal cord by the same route as cutaneous nociceptors. Visceral afferent nociceptors converge on the same pain projection neurons as do afferents from the skin. Within the spinal cord, there is a substantial mixing of information from these two sources of input. This cross-talk gives rise to the phenomenon of referred pain, in which visceral nociceptor activation is perceived as a cutaneous sensation (Meyer *et al.*, 1985; Fields, 1978).

When any of the visceral organs malfunctions, positive reactions such as sensitivity or tenderness will be manifested at the corresponding Back-Shu points (O'connor and Bensky, 1988). When there is dysfunction of the visceral organs, it creates pain and sensation at the Back-Shu points related to these organs (O'connor and Bensky, 1988; Teitelbaum, 2000).

Cutaneous-Visceral Reflex

Cutaneous-visceral reflex, irritation of a skin point, influences the organ functionally because the cutaneous area is connected to the neurotomes. Somatosensory inputs from the skin and/or muscle are involved in the control of various autonomic functions (Jansson, 1969; Kehl, 1975; Koizumi *et al.*, 1980). In acupuncture application, Back-Shu points are used in the treatment of visceral disease (Teitelbaum, 2000). Utilizing acupuncture on the Back-Shu points awakens the cutaneous-visceral reflexes, and this causes a regulated effect on related organ.

The same accurate neurotomic distribution of the acupuncture points seems to be preserved by the Urinary Bladder (UB) meridian. The Back-Shu points of the lung (UB 13) and pericardium (UB 14) have been used for centuries to treat lung diseases. All these points correspond dermatologically to the outlets of the sympathetic chain of the dorsal lung plexus (second, third and fourth thoracic sympathetic ganglions). The large bronchial tubes are autonomously innervated by this sympathetic plexus as well as the division of the trachea and all vessels that transport blood to the bronchial tree (Guyton and Hall, 2001; Williams *et al.*, 1999).

Researches regarding cutaneous-visceral reflexes have been performed which focuses on gastrointestinal function. In some of those investigations, there is a good evidence indicating the importance of cutaneous-sensory inputs in the autonomic control of gastrointestinal motility. In anesthetized rats, for instance, it has been shown that cutaneo-gastric reflexes mediate the inhibition and stimulation of gastric motility via sympathetic and parasympathetic afferents, respectively (Koizumi *et al.*, 1980; Kametani *et al.*, 1979; Sato *et al.*, 1975). It was shown that the cutaneo-sensory stimulation induced by pinching the abdominal skin of rats inhibits gastric motility by increasing sympathetic activity. Conversely, cutaneo-sensory stimulation induced by pinching the hind limb enhances gastric motility by increasing vagal activity (Kametani *et al.*, 1979).

In agreement with gastric segmental innervations, chemical gastric inflammation with mustard oil in rats results in neurogenic plasma extravasations in the skin, over the entire abdomen and middle and lower back. Neuroanatomically, these somatic territories belong to T 4–L 1 dermatomes (Takahashi and Nakajima, 1996). Segments of the autonomic

fibers of stomach and T 4–L 1 dermatomes are in similar regions. The Back-Shu points of the stomach are situated at the level of the 12th thoracic vertebra. Regulatory effects of stimulation and inhibition on gastric motility appear to be somatotopically organized at the acupoints of whole body, and the effective regularity of site-special acupoints on gastric motility is involved in segmental innervations between the stomach and acupoints (Li *et al.*, 2006).

At the level of the second sacral foramen of Back-Shu points (UB 28), the sacral preganglionic parasympathetic fibers extend from the spinal cord, via the second sacral nerves, which form the pelvic plexuses, to the terminal ganglia of the pelvic plexuses. After that, these postganglionic parasympathetic fibers end at the urinary bladder (Guyton and Hall, 2001; Williams *et al.*, 1999). Therefore, stimulation of UB 28 may regulate the detrusor muscle of the Urinary Bladder.

To summarize, sympathetic innervation of the lung, pericardium, heart, liver, gall bladder, spleen, and stomach, and the Back-Shu points level on these organs, are the same. In addition, the parasympathetic innervation level and the Back-Shu level at the Urinary Bladder are also the same. This demonstrates the relationship between the autonomic system and Back-Shu points. From these data, we believe that acupuncture at Back-Shu points can regulate the sympathetic and the parasympathetic activities that affect visceral organs.

References

- Bear, M.F., B.W. Connors and M.A. Paradiso. Chemical control of the brain and behavior. In: M.F. Bear, B.W. Connors and M.A. Paradiso (eds.) *Neuroscience Exploring the Brain*. Lippincott Williams & Wilkins, Philadelphia, 2007, pp. 481–508.
- Cabioglu, M.T. and N. Ergene. Electroacupuncture therapy for weight loss reduces serum total cholesterol, triglycerides, and LDL cholesterol levels in obese women. *Am. J. Chin. Med.* 33: 525–533, 2005.
- Cabioglu, M.T., N. Ergene and U. Tan. The mechanism of acupuncture and clinical applications. *Int. J. Neurosci.* 2: 115–125, 2006.
- Cheng, X. *Chinese Acupuncture and Moxibustion*. Foreign Languages Press, Beijing, 1987.
- Fields, H.L. *Pain*. McGraw-Hill, New York, 1978.
- FitzGerald, M.J.T. and J. Folan-Curran. Autonomic nervous system and visceral afferents. In: M.J.T. FitzGerald and J. Folan-Curran (eds.) *Clinical Neuroanatomy and Related Neuroanatomy*. WB Saunders, Edinburgh, 2002, pp. 85–101.
- Gray, H. *Anatomy of Human Body*, 37th ed. Churchill Livingstone, London, 1995.
- Guyton, A.C. and J.E. Hall. Autonomic nervous system and adrenal medulla. In: A.C. Guyton and J.E. Hall (eds.) *Textbook of Medical Physiology*. WB Saunders, Philadelphia, 2001, pp. 697–708.
- Jansson, G. Extrinsic nervous control of gastric motility. An experimental study in the cat. *Acta Physiol. Scand. Suppl.* 326: 1–42, 1969.
- Kametani, H., A. Sato, Y. Sato and A. Simpson. Neural mechanisms of reflex facilitation and inhibition of gastric motility to stimulation of various skin areas in rats. *J. Physiol.* 294: 407–418, 1979.
- Kehl, H. Studies of reflex communications between dermatomes and jejunum. *J. Am. Osteopath. Assoc.* 74: 667–669, 1975.

- Keith, L.M. *Clinically Oriented Anatomy*, 3th ed. Williams and Wilkins, Baltimore, 1992.
- Koizumi, K., A. Sato and N. Terui. Role of somatic afferents in autonomic system control of the intestinal motility. *Brain. Res.* 182: 85–97, 1980.
- Lai, X. Combined use of acupuncture and blood-injection at the Back-Shu points for treatment of allergic asthma — a report of 80 cases. *J. Tradit. Chin. Med.* 17: 207–210, 1997.
- Li, Y.Q., B. Zhu, P.J. Rong, H. Ben and Y.H. Li. Effective regularity in modulation on gastric motility induced by different acupoint stimulation. *World J. Gastroenterol.* 12: 7642–7648, 2006.
- Mayer, D.J. Biological mechanisms of acupuncture. *Prog. Brain Res.* 122: 457–477, 2000.
- Meyer, R.A., J.N. Campbell and S.N. Raja. Peripheral neural mechanisms of cutaneous hyperalgesia. In: H.L. Fields, R. Dubner and F. Cervero (eds.) *Advances in Pain Research and Therapy*. Raven Press, New York, 1985, pp. 53–71.
- O'Connor, J. and D. Bensky. An overview of the points. In: J. O'Connor and D. Bensky (eds.) *Acupuncture*. Eastland Press, Washington, 1988, pp. 119–140.
- Pintov, S., E. Lahat, M. Alstein, Z. Vogel and J. Barg. Acupuncture and the opioid system: implications in management of migraine. *Pediatr. Neurol.* 17: 129–133, 1997.
- Sato, A., Y. Sato, F. Shimada and Y. Torigata. Changes in gastric motility produced by nociceptive stimulation of the skin in rats. *Brain Res.* 87: 151–159, 1975.
- Snell, R.S. *Clinical Anatomy for Medical Students*, 4th ed. Little, Brown and Company, Boston/Toronto, 1992.
- Sovijarvi, A.J. and H. Poppius. Acute bronchodilating effect of transcutaneous nerve stimulation in asthma. A peripheral reflex or psychogenic response. *Scand. J. Respir. Dis.* 58: 164–169, 1977.
- Takahashi, Y. and Y. Nakajima. Dermatomes in the rat limbs as determined by antidromic stimulation of sensory C-fibers in spinal nerves. *Pain* 67: 197–202, 1996.
- Teitelbaum, D.E. Osteopathic vertebral manipulation and acupuncture treatment using front mu and Back-Shu points. *Med. Acupunct.* 12: 36–37, 2000.
- Tortora, G.J. *Principles of Human Anatomy*, 4th ed. Harper and Row Publishers, New York, 1986.
- Wang, M. and Y. Zhu. Clinical experience of Dr. Shao Jingming in treatment of diseases by puncturing Back-Shu points. *J. Tradit. Chin. Med.* 16: 23–26, 1996.
- Williams, P.L., R. Warwick, M. Dyson and L.H. Bannister. *Gray's Anatomy*. Churchill Livingstone, London, 1999.
- Zhang, W.P. Effects of acupuncture for dispersing fei, invigorating pi and reinforcing shen on heart rate variability and pulmonary function in bronchial asthma patients. *Zhongguo Zhong Xi Yi Jie He Za Zhi* 26: 799–802, 2006.

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