

Mechanism of Scalp Acupuncture Combined with Distal Acupoint Selection in the Treatment of Vascular Headache Caused by Hyperactivity of Liver-Yang

Rongrong QI¹, Hui LI¹, Wenting LIU¹, Tinghui LIU¹, Huitao SU¹, Jie YUAN¹, Xinghua MA¹, Yuting ZHANG¹, Yaling LEI^{1,2*}

1. Shaanxi University of Chinese Medicine, Xianyang 712046, China; 2. Shaanxi Hospital of Traditional Chinese Medicine, Xi'an 710003, China

Abstract The clinical effect of acupuncture on vascular headache caused by hyperactivity of liver-yang has been shown, but the specific mechanism is not yet clear. This paper is intended to discuss the etiology and pathogenesis of vascular headache caused by hyperactivity of liver-yang and the mechanism of acupuncture, so as to provide a certain reference for clinical diagnosis and treatment of scalp acupuncture treatment of vascular headache caused by hyperactivity of liver-yang.

Key words Acupuncture, Scalp acupuncture, Distal acupoint selection, Headache

1 Introduction

Vascular headache is mainly due to increased intracranial vascular resistance, systolic dysfunction, and increased tension^[1]. It is characterized by high morbidity, severe headache at the time of attack, difficult to cure, and easy to recur^[2]. Vascular headache is mainly divided into migraine headache and blood pressure-related headache. Due to its unclear pathogenesis, modern medicine mostly gives symptomatic treatments such as sedation and anti-inflammatory, and there is a phenomenon of repeated after stopping the drug. Once the medication time is prolonged, the body is prone to drug resistance, the efficacy of the drug declines, the adverse reactions increase, then it will become very difficult to cure, and the clinical effect is not ideal^[3]. At present, due to the increased pressure of work and life, the possibility of staying up late, depression or anger increases, such conditions will cause headaches, which are mostly attributed to the syndrome of hyperactivity of liver-yang in traditional Chinese medicine. As a result, the incidence of vascular headache caused by hyperactivity of liver-yang is increasing year by year^[4], which brings great trouble to the normal work and life of patients. Traditional Chinese medicine attributes all types of headaches to "head wind" and "brain wind"^[5], and the *Plain Questions · Wind* stated that "If the wind qi moves up with the wind house, it will become the brain wind". In terms of treatment, traditional medicine uses acupuncture, moxibustion, tuina, cupping and other therapies to treat various types of headaches with remarkable effects and few adverse reac-

tions, which is more and more accepted by modern people. The TCM symptom type of vascular headache is mainly divided into phlegm turbidity obstruction, qi stasis and blood stasis, hyperactivity of liver-yang, *etc.*, among which hyperactivity of liver-yang type is more common^[6], so we mainly discussed about it in this study.

2 Etiology and pathogenesis

From the perspective of internal organ function, hyperactivity of liver-yang is mainly related to the free coursing of the liver, and if the free coursing is too much, the qi movement is chaotic and causes headache. In the physiological process, the liver can also regulate the operation of the qi movement through its drainage function, so that the liver qi can be adjusted and the qi movement can be unblocked, thereby alleviating the body's symptoms.

From the perspective of course of the meridian and collateral, the course of Jueyin liver meridian of foot (LR) is up to the top of the head and down to the soles of the feet, and meets the governor vessel at the top of the head. In the yin meridians, only the liver meridian reaches the top of the head, and meets with the yang meridians, which means to control the yang with yin, and once its yang qi is exuberant, this balance will be broken, and the tranquility of the house of the original spirit will be destroyed, resulting in a headache. Therefore, most scholars believe that the appearance of headache is closely related to the liver^[7]. According to the specific symptoms of vascular headache, TCM attributes its etiology to hyperactivity of liver-yang, which disturbs the clear mind and causes headache^[8]. Specifically, it can be divided into two aspects, on the one hand, emotion is constrained, liver qi stagnation, liver qi depression heat and fire injuring yin, liver yin deficiency failure to wet the liver body, yin blood deficiency yang leading to failure to submerge, resulting in liver-yang hyperactivity, disturbing the clear orifices and causing headache; on the

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* Corresponding author. E-mail: ia678@qq.com

other hand, kidney water is insufficient and unable to move upward to nourish clear orifices, kidney yin deficiency leads to remaining downward, water does not preserve wood, failing to restrict liver-yang from above, and lead to hyperactivity of liver-yang, qi movement disorder, consequently causing headache. As stated in *A-B Classic of Acupuncture and Moxibustion • Volume IV • Discussion on Yin and Yang*, when qi moves upward rather than downward, the headache occurs, which is consistent with the statement of upward movement of liver-yang qi leading to headache. According to *Complete Works of Jingyue • Headache*, water deficiency and remains downward, the deficiency fire will flame upward. Thus, the kidney water can not nourish the liver wood and cause the deficiency fire to inflame and disturb the ventricles of the brain, which leads to headache. Both of them can become disease alone or together. Deficiency of liver-yin leads to hyperactivity of liver-yang, which leads to excess due to deficiency. For a long time, excess leads to deficiency. Liver-yang plunders kidney-yin and liver-kidney yin is deficient. As stated in *Plain Questions • Essentials on Disease and Therapy*, various manifestations of convulsions and vertigo of wind are mostly due to liver lesions. According to *A-B Classic of Acupuncture and Moxibustion • Volume IV • Discussion on Diseases of Five Viscera and Five Flavors*, patients with liver disease have pain under both flanks, leading to qi counterflow, which accordingly causes headache, both emphasize the importance of the liver in the pathogenesis of headache^[9]. Therefore, in the course of treatment, it is necessary to start from the liver, follow the principle of calming the liver and suppressing yang, nourish water and wood, and regulate qi, so that the liver qi can be regulated, the emotions can be unblocked without suspicion of depression, and headache can not occur.

3 Headache treatment

3.1 Brief description of headache treatment For the treatment of various types of headache, Western medicine mainly gives various types of anti-inflammatory and analgesic drugs, tricyclic antidepressants and antihistamines^[10–11]. Anti-inflammatory and analgesic drugs, such as non-steroidal anti-inflammatory drugs ibuprofen, acetaminophen, ketoprofen and so on, can relieve the pain of patients in a short time, but most of them can not be cured, and long-term use of side effects is obvious, easy to cause digestive tract symptoms, and even induce excessive drug headache. Tricyclic antidepressant drugs, such as amitriptyline, have to contend with side effects and can not be used for a long time. Antihistamines, such as betahistine, can relax blood vessels and improve headache caused by abnormal vasoconstriction in a short time, but long-term use of betahistine can easily cause heart, metabolic and nervous system diseases^[12]. TCM is mainly used to treat various types of headache with traditional Chinese medicine decoction^[13], such as Tianma Gouteng Decoction for patients with hyperactivity of liver, and Dabuyuan Decoction for patients with liver and kidney yin deficiency. Patients need long-term medication to achieve the corresponding therapeutic effect, which

has the problems of long course of treatment and poor patient dependence. For vascular headache caused by hyperactivity of liver yang, scalp acupuncture was used to relieve the symptoms of local headache. Cooperating with distal acupoint selection to guide hyperactivity of liver-yang, it can treat both manifestation and root cause of the disease, and it is economical, simple and effective.

3.2 Scalp acupuncture: treating symptoms As stated in *Miraculous Pivot • Sea*, the brain is the sea of marrow, and its output is in the top of the skull, and the next is in wind house. This provides a theoretical basis for scalp acupuncture to treat diseases, and also illustrates the relationship between scalp and brain from the side. The scalp acupuncture combines the traditional meridian theory with the functional division of the cerebral cortex in modern medicine to divide the head for acupuncture, which has good curative effect and little side effects^[14]. Up to now, there are hundreds of diseases treated by scalp acupuncture, but the effect of scalp acupuncture on brain-derived diseases is more prominent^[15], which further verifies the statement that "where the acupuncture point is, where the indication is". Scalp acupuncture can be divided into four areas and fourteen lines^[16] according to the principle of "dividing areas to determine meridians, selecting acupoints on meridians, and combining with the traditional acupoint penetration method". For vascular headache caused by hyperactivity of liver-yang, the midfrontal line, the midparietal line, the anterior temporal line and the posterior temporal line can be selected for treatment. Both the frontal midline and the parietal midline belong to the governor vessel. The frontal midline is located in the middle, 0.5 cun (one cun is about 3.3 cm) above and below the anterior hairline, that is, the Shenting point is needled 1 cun downward, and the parietal midline is located to the anterior parietal point. According to *Miraculous Pivot • Meridians*, for meridian diseases, the excess indicates strong spine, while deficiency indicates headache. Acupuncture at Baihui of the governor vessel can calm the nerves, regulate qi and blood of the yang meridians, and dissipate the hyperactive liver-yang invisibly. Both the anterior temporal line and the posterior temporal line belong to the Shaoyang Gall Bladder Meridian of Foot. The anterior temporal line is located in the two temples of the head, at the anterior hairline of the lower part of the frontal horn, from the point of Hanyan to the point of Xuanli. The posterior temporal line is located above the temporal ear, from the point of the ear tip to the point of Qubin. According to records of *Miraculous Pivot • Meridians*, headache and jaw pain are the diseases caused by Jueyin liver meridian of foot. The liver and gallbladder meridians are interiorly and exteriorly related to each other, and the yang qi of the liver meridian attacks upward, resulting in headache. Acupuncture at the points of the gallbladder meridian can dredge the orifices, dredge the collaterals and relieve pain. The comprehensive application of multiple lines of scalp acupoints can give consideration to both symptoms and root causes and improve headache.

3.3 Distal acupoint selection: treating the root As stated in

Miraculous Pivot · Meridians, where the meridians pass, where the indications reach. Therefore, in the acupuncture treatment of vascular headache caused by hyperactivity of liver-yang, distal acupoints can be selected to guide the downward movement of hyperactivity of liver-yang^[17]. In *Miraculous Pivot · Needling Method*, distal acupoint selection is called "distant needling", and it is also said that "if the disease is upper, the acupoint should be selected from the lower", which provides a theoretical basis for distal acupoint selection to treat diseases. As stated in *Miraculous Pivot · 9 Classical Needles and 12 Source Points*, if there is a disease in the five viscera, it should select the 12 source points, and each of the twelve source point has its own source. Knowing the source and observing the response, one knows the harm of the five viscera. Thus it can be seen that once pathological changes occur in the viscera, specific acupoints on the corresponding meridians can be selected for treatment. Therefore, according to the meridians, etiology and pathogenesis of vascular headache caused by hyperactivity of liver-yang^[18], the distal acupoint selection along the meridians are mostly selected from points such as Jueyin Liver Meridian of Foot, Shaoyang Gall Bladder Meridian of Foot and Shaoyin Kidney Meridian of Foot. For this type of headache, Taichong, Hegu, Xingjian, Qixu, Zulinqi, Taixi and so on are often used clinically. Taichong is both the source point and the Shu point of the Jueyin Liver Meridian of Foot, which can calm the liver and descend the counterflow and guide the ascending counterflow to descend for the patients with hyperactivity of yang qi of the liver meridian. Shu point governs the diseases of body weight. It again proves that Taichong acupoint can treat the corresponding pain. Hegu is the only selected acupoint on the upper limb, which is mainly used in combination with Taichong to form the meaning of "opening the four passes". The clinical application of Siguan can refresh the brain and restrict the liver-yang. Xingjian point is liver meridian brook point, which governs the body heat. Hyperactivity of liver-yang is characterized by distending pain in the head, flushed face and red eyes, irritability, red tongue with little body fluid, and taut or thin pulse, all of which are heat symptoms. Liver meridian brook point can relieve fever and pain, and regulate liver meridian qi. In *Complete Compendium of Acupuncture and Moxibustion (Volume V)*, Yang Jizhou stated that disease of face and headache should select Qixu and Ligou points. Qixu is the source point of the gallbladder meridian, and the liver and gallbladder meridians are interior-exteriorly related. Acupuncture at Qixu can make the original qi of the triple energizer flow smoothly throughout the body, so as to maintain healthy qi and resist pathogenic factors, so as to cooperate with the therapeutic effect of the points selected by its main meridian. Zulinqi is the point of gallbladder meridian, the gallbladder meridian passes through the side of the head, and the selection of Zulinqi also implies that "where the meridian passes through, the indications reach", Taixi is the source point of Shaoyin Kidney Meridian of Foot, which can nourish yin and tonify the kidney. For patients with hyperactivity of liver-yang, it can nourish water and nourish wood, and nourish

kidney yin to restrict liver-yang.

4 Action mechanism

4.1 Ancient views According to the TCM theory, pain is understood as "where there is blockage, there is pain" and "where there is no nourishment, there is pain"^[19], which divides the pain into "excess pain" and "deficiency pain". Physicians in the past dynasties have also made a more systematic exposition of this. As stated in *Plain Questions · Differentiation of Pain*, qi and blood in the meridians of the human body are prevalent, such as endless rings. If pathogenic cold invades the meridians, the circulation of qi and blood in the meridians will be sluggish, astringent and not smooth, so the invasion of pathogenic cold inside and outside the meridians will cause the meridians to be astringent and less blood, and the qi in the meridians will be blocked, so sudden pain will occur. This indicates the pain mechanism of "where there is blockage, there is pain" due to the disorder of qi and blood circulation. In the *Precious Mirror of Hygiene*, there is opinion that "the more deficiency of clear yang qi, the less the nourishment, accordingly leading to headache". As indicated in *Questioning Records of Difficult and Complicated Diseases*, insufficient liver blood can cause muscle spasm, dizziness, headache, hypochondriac pain, lower abdominal pain, and colic, all of which are due to liver blood deficiency, which further reflects that deficiency can lead to pain. According to the TCM theory, acupuncture achieves the purpose of analgesia by regulating the circulation of qi and blood, eliminating pathogens and strengthening the body resistance^[20]. The key of the needling method lies in knowing how to regulate qi. For the "excess pain" due to the blockage of visible excess pathogens, it can dredge the channels and collaterals, promote the circulation of qi and blood, and improve the state of stagnation of local channels and collaterals, so as to achieve the purpose of "no pain"; for the "deficiency pain" due to the deficiency of qi and blood, it can support the healthy qi, dispel the pathogenic factors, and improve the body's ability to resist pain, so as to reduce the occurrence of pain.

4.2 Present opinions Modern medicine has a deeper understanding of acupuncture analgesia, believing that it is a complex network regulation mechanism, involving the regulation of the central and peripheral nervous systems at all levels^[21]. Previous studies have shown that among a wide variety of treatments including traditional Chinese medicine, western medicine and neuroelectric physiotherapy, acupuncture has the most obvious and long-lasting effect on headache^[22]. At present, it is believed that the mechanism of acupuncture analgesia is mainly related to neurotransmitters, but the specific mechanism is still not clear^[23]. Neurotransmitter is the material basis of the interaction between nervous systems, which undertakes the transmission work of the operation of the nervous system network. Studies have indicated that acupuncture for local micro-stimulation can cause local mast cells to produce inflammatory reaction, release neurotransmitters, and change the content and activity of corresponding neurotransmitters^[24].

The 5-hydroxytryptamine (5-HT), endothelin (ET) and nitric oxide (NO) are the main neurotransmitters involved in head analgesia^[25], and 5-HT is the main analgesic neurotransmitter in headache. After acupuncture treatment, the content of 5-HT in the blood of patients increased significantly, 5-HT receptors could reduce the secretion of vasoactive substances, the relaxation and contraction of cerebral blood vessels slowed down, and the intensity of headache was alleviated. As vasodilators and vasoconstrictors, NO and ET can directly improve the blood circulation of brain tissue. When stimulated by local acupuncture, the secretion and release of NO and ET in the blood will be reduced, thus adjusting the abnormal contraction of blood vessels in the brain to normal levels, thus improving headache symptoms.

4.3 Analgesic mechanism of scalp acupuncture Scalp acupuncture has unique advantages in the treatment of cerebrogenic diseases, especially cerebrovascular diseases. Studies have shown that acupuncture at scalp points can significantly reduce the discharge frequency of neurons^[26]. Under the same stimulation intensity, the analgesic effect of acupuncture at scalp and facial points is better than that of other nerve segments. Under the condition of non-painful stimulation, only the scalp and facial points of the same nerve segment can produce analgesic effect. The stimulation and sensation of scalp acupuncture can regulate local vasomotion, improve the blood supply of the head, and enhance the mutual signal transmission between intracranial and extracranial. The stimulation and sensation of the head are mainly controlled by the trigeminal nerve^[27]. The nerve fibers of the cerebral cortex pia mater, which dominate the intracranial sensation, are also controlled by the trigeminal nerve. Acupuncture at scalp points can reduce the content of nociceptive transmitters released by nerve endings and reduce the transmission frequency of nociceptive information, thus achieving the analgesic effect on the trigeminal nerve. It has been known that sensory afferents from the meninges and craniofacial afferents are involved in the spinal trigeminal nucleus and trigeminal ganglion^[28]. In addition, through anatomy, it is found that the anterior temporal line and posterior temporal line of scalp points are located in the distribution area of the cutaneous branches of the trigeminal nerve. By stimulating the lines of scalp points, the function of the vascular system of the trigeminal nerve can be regulated, the activation of platelets can be reduced, and neurogenic inflammation can be alleviated, so as to achieve the analgesic effect. On the other hand, under the pathological basis of long-term chronic pain, patients will produce a painful mood, which is manifested as anxiety, depression, restlessness and so on. Studies have shown that traditional Chinese medicine acupuncture, especially microneedles system (scalp acupuncture, auricular acupuncture, *etc.*), has a more intuitive effect on pain^[29]. It can relieve various types of headache and also can soothe the potential pain and relieve the stress and anxiety caused by pain.

4.4 Mechanism of distal acupoint analgesia From the perspective of modern medicine, acupuncture at distal acupoints can

achieve the purpose of analgesia, and its mechanism of action may be related to reducing vascular pressure, improving the flow and speed of cerebral blood flow, and acting on the corresponding brain areas^[30–31]. As stated above, for the distal acupoint selection of the vascular headache caused by hyperactivity of liver-yang, Interline and Taichong of Jueyin Liver Meridian of Foot and Zulinqi and Qiuxu of Shaoyang Gall Bladder Meridian of Foot, Taixi acupoint of Shaoyin Kidney Meridian of Foot, Hegu acupoint of Large Intestine Meridian of Hand Yangming can be selected. Studies have shown that when Taichong acupoint is stimulated with moderate intensity, the content of endothelin in plasma can be reduced and the content of carbon monoxide can be increased, so as to relax blood vessels and reduce blood pressure. When Xingjian acupoint is needled with the same method, the level of endothelin in plasma can also be reduced, so as to reduce the peripheral resistance of blood vessels and relieve headache^[32]. At the same time, Xingjian and Taichong are brook point, Shu point and source point of the Jueyin Liver Meridian of Foot. Needling these three points together with the heavy stimulation technique of "Xingjian penetrating Taichong" can quickly relieve vasospasm and improve headache symptoms^[33]. According to the blood flow velocity detected by transcranial Doppler, it was found that the blood flow velocity of posterior cerebral artery, basilar artery and vertebral artery increased after acupuncture of Taichong point. Therefore, relieving vascular headache by needling Taichong may be related to improving the mechanism of cerebral circulation and blood supply. Taichong and Hegu are called four key acupoints".

Through fMRI studies, it is found that acupuncture at these four key acupoint can activate multiple brain functional areas, make the brain show more extensive neural activity^[34], and has a two-way regulation effect on cerebral blood flow in headache. Its analgesic mechanism may be related to the level of neurotransmitters and the hyperalgesia of trigeminal nerve. Through this study, it was also found that the compatibility of Taichong and Hegu acupoints could induce the increase of blood flow volume and blood flow rate of frontal and parietal brain tissue acupoints. In addition, Taixi, as the source point of Shaoyin Kidney Meridian of Foot, combined with Taichong, can significantly improve the symptoms of yin deficiency and yang hyperactivity. Patients with hyperactivity of liver-yang headache are mostly accompanied by a painful mood. Studies have found that Taichong combined with Taixi can affect the control of emotion, language and other related brain areas, increase the cerebral blood flow and active substances in the corresponding brain areas, thereby alleviating the pain^[35]. The only source of energy for brain cells is the glucose produced by the body. Studies have shown that the metabolic rate of glucose in the brain increases when needling Taichong and Taixi points^[36], and the intensity of brain activity is positively correlated with the metabolic rate of glucose in the brain. In other words, needling Taichong and Taixi points can activate some brain regions, increase the activity of the corresponding brain regions and relieve headache. As mentioned above, if there is a disease in the

five viscera, it should select the 12 source points, and each of the twelve source point has its own source. The source point QiuXu of the gallbladder meridian can be selected to treat the hyperactivity of liver-yang type headache. Studies have shown^[37] that during the onset of migraine, the abnormal fluctuation of 5-HT level causes abnormal contraction of intracranial blood vessels. Needling QiuXu point can significantly increase the 5-HT level in plasma, thereby reducing the occurrence of headache.

5 Discussion

The vascular headache is mostly related to the dysfunction of liver, spleen, kidney and other organs, especially the liver. From the point of view of modern medicine, people with hyperactivity of liver-yang often show symptoms of hypertension. Therefore, to improve the related symptoms of hyperactivity of liver-yang, on the one hand, we should maintain emotional stability and regular life, and take certain medical measures to prevent and treat them, so as to achieve the goal of "prevention before disease, preventing change in case of disease". On the other hand, when the hyperactivity of liver-yang headache, abnormal contraction of blood vessels in the brain, it prompts to be a dangerous signal, so the choice of appropriate means of prevention and treatment is the most critical. Vascular headache caused by hyper activity of liver-yang has a long course of disease and poor patient compliance. Although there are many kinds of treatment, scalp acupuncture combined with distal acupoint selection is undoubtedly the most appropriate means from the perspective of therapeutic effect, economy, simplicity and easy operation. The local acupoint selection is adopted to relieve headache symptoms, and the distal acupoint selection is adopted to eliminate pathogenic factors, and the two are mutually matched to soothe the liver and lower the counterflow of qi and dredge yin and yang. In addition, as a kind of micro-needle manipulation, scalp acupuncture can also relieve the pain caused by pain. Furthermore, the scalp acupuncture and distal acupoint selection have achieved good clinical results in vascular headache. Various studies have found that the effect of relieving headache may be related to the regulation of vasomotion, the regulation of the release level of neurotransmitters and vasoactive substances, but its specific mechanism of action is also being explored. It is hoped that the related mechanism of action can be further found in future studies, so as to better guide clinical practice.

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