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Clinical Advances in Acupuncture and Medical Imaging Research Applications

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Abstract: ***The rapid development of modern science and technology, the application of medical imaging in medicine is constantly deepening, and its research cases in the mechanism of action and clinical effects of acupuncture are more and more and have achieved more significant research results, this paper mainly discusses the relevant applications of ultrasound, MRI, CT in the study of acupuncture and its clinical treatment, and envisages the focus and objectives of the joint application of research in acupuncture and medical imaging with a view to promote the development of their research applications.***

Keywords: Acupuncture, Imaging, Ultrasound, CT, MRI.

1. Introduction

Acupuncture imaging is a cross-discipline combining acupuncture and imaging, which mainly includes acupuncture visualisation, imaging study of the action mechanism of acupuncture, and acupuncture imaging diagnosis. Acupuncture visualisation refers to the use of medical imaging technology to visualise acupuncture points, meridians, and qi and blood flow during acupuncture treatment, in order to intuitively understand the mechanism of action of acupuncture. Acupuncture visualisation studies mainly include changes in local tissue blood flow, vascular status and nerve conduction before and after acupuncture, as well as information on the depth, width and location of acupuncture points during acupuncture. The imaging study of acupuncture action mechanism mainly explores the effect of acupuncture on the physiological function of the organism and its mechanism of action. For example, the effect of acupuncture on organ function, on the nervous system, on the immune system. Acupuncture imaging diagnosis refers to the use of medical imaging technology for diagnosis and differential diagnosis of diseases, mainly including the application of X-ray, ultrasound, CT, MRI and other imaging technologies. Acupuncture imaging diagnosis can help doctors more accurately determine the site and nature of the lesion, providing a more accurate basis for acupuncture treatment. Overall, the development of acupuncture imaging not only helps to improve the therapeutic effect of acupuncture, but also helps to promote the in-depth development of acupuncture research.

2. Relevant Theories of Acupuncture

Acupuncture and moxibustion theory is based on the basic theories of traditional Chinese medicine, with meridian theory as the main body, the doctrine of internal organs as the basis, Ying, Wei, Qi, blood, fluid as the material basis, yin and yang, five elements as its general law, the principle of acupuncture and moxibustion therapy as its basic treatment principles, meridian points, collateral points and extra-meridian odd points as its treatment of the acupuncture points. Meridian theory is an important part of the theory of Chinese medicine, including the distribution of the meridian system and the distribution of the route, as well as the physiological and pathological relationship with the body's internal organs and tissues. Acupuncture and moxibustion have been used clinically for thousands of years as a therapeutic modality, including needling and moxibustion, i.e., the application of various sizes of acupuncture needles and moxa products to stimulate acupoints or pain points on the body surface to produce therapeutic effects. Acupuncture and moxibustion stimulation can act on the meridians themselves, playing a role in clearing the meridians and regulating the qi and blood within the meridians, thus affecting the whole body and achieving the purpose of treating diseases.

3. The Link between Acupuncture and Imaging

As acupuncture goes out of the country to face the world, the research on the mechanism of action of acupuncture has attracted much attention. At present, the appropriate technology of acupuncture is mainly based on various therapeutic methods such as millimetre acupuncture, electroacupuncture, fire acupuncture, cupping therapy, etc., and it is also the most widely used traditional Chinese medicine technology [1]. Acupuncture and moxibustion is a kind of natural therapy, with a wide therapeutic range, small side effects, quick results, easy to operate, economic and safety characteristics. Its mechanism of action mainly includes dredging meridians and collaterals, regulating qi and blood, supporting the positive and dispelling the evil, activating blood circulation and removing blood stasis. With the development of modern science and technology, more and more experts and scholars are interested in acupuncture to treat diseases, but up to now, the mechanism of acupuncture is not clear, the traditional Chinese medicine uses the ‘Secretary outside the speculum inside’ research method, which is called ‘black box theory’ by some scholars. However, through various modern imaging techniques, the mechanism of action of acupuncture has been made transparent, which further strengthens the chain of evidence for the treatment of disease by acupuncture [2,3,4]. Acupuncture is a therapeutic method that regulates internal body functions and relieves pain by stimulating specific acupuncture points. Imaging technology, on the other hand, is a method that shows the internal structure

and function of the body through images. Acupuncture points are the basis of acupuncture treatment, and features such as the location and depth of the points can be observed and measured by imaging techniques. Through these imaging techniques, acupuncturists can locate acupuncture points more accurately and understand the relationship between the points and the surrounding tissues, so that they can better select the method of acupuncture and manipulation techniques. In acupuncture treatment, the acupuncturist needs to understand the patient's body structure and lesions through imaging techniques in order to select appropriate acupuncture points and acupuncture methods for treatment. At the same time, acupuncture treatment can also affect the performance and outcome of imaging through mechanisms such as influencing local blood circulation and neurotransmitter release. There is a strong link between acupuncture and imaging. Through imaging techniques, the mechanism of acupuncture on meridian points can be better explored. In conclusion, the combination of acupuncture and imaging not only helps to improve the therapeutic effect of acupuncture, but also helps to promote the in-depth development of acupuncture research.

4. Application of Ultrasound in Acupuncture Research

With the advancement of time and technology, the popularity of Chinese medicine has been increasing, and nowadays it has been translated into many languages with deepening internationalisation, and acupuncture is at the forefront and has become one of the most popular representative disciplines of Chinese medicine [5].The use of ultrasound in acupuncture is a new attempt to combine traditional acupuncture techniques with modern ultrasound techniques with the aim of increasing the precision of acupuncture treatment used in clinical practice as well as improving the therapeutic effect of acupuncture. The joint use of ultrasound during acupuncture treatment is a combination of traditional theory and modern technology, which has the effect of dredging the meridians and collaterals, balancing yin and yang, and adjusting the internal organs [6]. In the process of acupuncture treatment, due to improper human operation, it may cause problems such as bending needles, stagnant needles and broken needles [7]. The individual variability of acupuncture, the different selection of acupuncture points, the depth of needling is different, and there is a lack of relevant tests. Accompanied by the development of science and technology, the continuous innovation of therapeutic concepts, ultrasound is gradually applied to the clinical treatment of acupuncture and efficacy research, these problems have been well solved. Specifically, in the clinical treatment of acupuncture and moxibustion, ultrasound can be jointly applied to the diagnosis of disease and evaluation of the efficacy of the following aspects: (1) ultrasound medicine is used to evaluate the intervention effect of acupuncture and moxibustion on the patient's organ blood flow; (2) ultrasound medicine can be used to evaluate the intervention effect of acupuncture and moxibustion on the patient's organ activity [8]. In the clinical acupuncture treatment, with the ultrasound detection, can effectively improve the therapeutic effect [9]. Zou Lu [10] and others used ultrasound-guided needling of the Neiguan point, combined with electroacupuncture for preoperative anaesthesia for gynaecological laparoscopic surgery, and the results showed that through the combination of musculoskeletal ultrasound and needling, the use of propofol was effectively reduced, and the patient's postoperative awakening time was accelerated, which could effectively promote the postoperative recovery. Wang Yuqing [11] and others used ultrasound-guided needling in patients with frozen shoulder, taking the contralateral striated mouth and Chengshan acupoints for precise penetration, and learnt through thermal imaging analysis that ultrasound guidance has clear anatomical layers, which can promote its thermal balance, and the observation group had a stronger sense of getting qi needles. Tu Jie [12] and others used ultrasound-guided needling of the human foot Sanli acupoint, and found that through ultrasound guidance and accurate positioning of the acupoint, its effect of relieving local myofascial tension and restoring vascular flow was more persistent than that of non-meridian non-acupoints. Wang Chao [13] et al. chose ultrasound-guided acupuncture treatment for excitation pain points in the neck and shoulder region, which could inactivate the excitation pain points more precisely, and its effect of loosening local adhesions and relieving pain was more superior. Gu Wenliang [14] and others chose patients with neurogenic cervical spondylosis with symptoms in the shoulder and upper limb area, and acupuncture with ultrasound-guided needling at the Tian Ding point found that ultrasound-guided needling was more precise, with a stronger sense of obtaining qi, and with a higher degree of safety. In the process of acupuncture, combined with the monitoring of the current imaging technology ultrasound, to a certain extent, it makes acupuncture visualisation, and verifies and evaluates the efficacy of acupuncture [15]. Ultrasound acupuncture has a wide range of applications and can be used to treat various painful diseases, such as headache, cervical spondylosis, lumbar disc herniation, arthritis, etc. It can also be used to regulate the endocrine and immune systems, such as the treatment of menstrual disorders, menopausal syndromes and so on. In addition, ultrasound acupuncture can be used for diagnosis and differential diagnosis of acupuncture. The morphology and structure of acupuncture points and meridians can be clearly observed through ultrasound technology, which provides a more accurate basis for the diagnosis and differential diagnosis of acupuncture [16].

5. CT Examination in Acupuncture Research

Yang Shun et al [17] selected hemiplegic patients with cerebral infarction and carried out rehabilitation treatment based on acupuncture and moxibustion, and made a regular evaluation of the rehabilitation of the selected patients through regular CT examination, and at the same time, measured the change of cerebral infarction area of the selected patients based on CT examination, and found that in the treatment of hemiplegic patients caused by cerebral infarction, the treatment efficacy could be enhanced by cooperating with the means of traditional Chinese medicine, especially the combined use of acupuncture and rehabilitation. very effectively coordinates the patient's organism ability. For patients in the acute stage of ischemic stroke, warm acupuncture and moxibustion combined with Chinese herbal medicine injection was chosen to assess the recovery of neurological function by observing the cerebral perfusion and changes in cerebral hemodynamics. The results showed that

on top of the conventional treatment and rehabilitation for patients with acute cerebral infarction, the combination of warm acupuncture and moxibustion could significantly improve the cerebral perfusion level and cerebral hemodynamic abnormality of patients with acute ischemic stroke, and accelerate the recovery of neurological function [18]. Yang Yong [19] and others observed the anatomical position of the intervertebral disc and spinal canal in patients with lumbar disc herniation with the help of CT equipment, and divided them into five CT levels, and after the treatment by acupuncture, the results showed that when the acupuncture crossed the posterior longitudinal ligament, the effect of lifting the nerve compression was stronger, and the effect of their acupuncture treatment was significantly improved. The therapeutic range of the eightiosos points is wide, especially for gynecological diseases with clear efficacy, but it is more difficult to locate them in the clinic. Bai Tianyu [20] et al. verified that when acupuncture exceeded 70 mm and the tip of the needle passed through the presacral foramen, the therapeutic effect of the eightiosos point was more pronounced, and there was no adverse reaction when the acupuncture exceeded 70 mm and the tip passed through the presacral foramen. Sun Peiyu [21] and others used CT-assisted guidance for lumbosacral neuralgia and performed deep stimulation with millimetre-needle twisting manoeuvre, which was effective in accelerating the dissipation of inflammatory factors and relieving pain, and the soft-tissue tension at the painful site improved significantly compared with the pre-treatment period. Based on PET-CT technology, He Zhaoxuan [22] and others designed an optimised experimental procedure for stroke disease, an advantageous disease of acupuncture, which provided a more reasonable and standardised protocol for the study of the modern mechanism of acupuncture and its mechanism of action of acupuncture. Based on PET-CT brain imaging technology, Zhang Guifeng [23] and others found that the effect of acupuncture has multiple factors, and placebo acupuncture will have a certain effect, but the efficacy is significantly weaker than acupuncture points.

6. MRI in Acupuncture Research

The principle of fMRI is based on the enhancement effect of blood oxygenation level de pendent BOLD - when specific functional centres of the brain are stimulated (e.g. language centres, sensory centres), changes occur in the blood vessels in close proximity to each other, and the blood flow and volume within the vessels suddenly increase more than the oxygen consumption, so that the oxygenated haemoglobin content increases and the deoxygenated haemoglobin content is relatively low. The sudden increase in blood flow and volume is greater than oxygen consumption, resulting in an increase in oxygenated haemoglobin and a decrease in deoxygenated haemoglobin. fMRI is developing rapidly and has many advantages, such as it does not require the use of contrast media and has a high temporal and spatial resolution compared to other imaging methods, as well as being reproducible. It also has the advantages of good reproducibility, no ionising radiation, and analyses of brain function under non-invasive conditions [24]. fMRI can help researchers to obtain information about the functional areas of the brain that play a role in acupuncture treatment, and to prove the mechanism of the therapeutic efficacy of traditional Chinese medicine-acupuncture in the study. At the same time, we should also see that the existing literature reports mostly from a single perspective to explore the changes in the autonomous physiological functions of the organism and the improvement of pathological states triggered by the effects of acupuncture observed using fMRI technology [25]. With the development of modern science and technology, a large number of scholars are committed to the study of meridian substance and acupuncture mechanism, in the study of the mechanism of acupuncture and moxibustion, we can use fMRI reaction brain function activation area of the current imaging technology, used to more clearly and accurately reveal the mechanism of acupuncture, with a view to better guide the clinical treatment and reduce the patient's non-essential medical harm. For example, [26] the use of fMRI technology to study the connection between meridian sensory transmission and brain functional areas may lead to a more reasonable explanation among the many controversial hypotheses. fMRI, a modern imaging technology, was applied to the study of the connection between meridians and the brain, and showed that different meridians have specificity in the activation zones of the brain, and at the same time have cross-cutting identical activation zones, which is consistent with the distribution of meridians, the fourteen meridians and the fourteenth meridian, and the fourteen meridians and the fourteenth meridian, and the fourteen meridians of the brain. The distribution of meridians, the fourteen meridians and the eight odd meridians and their intermittent collaterals are released in different areas of the human body, and at the same time, there are connections between the meridians, which play a role in the human body together [27,28]. The discipline of acupuncture is one that advances with the times and develops with other disciplines in a continuous intermingling manner [29], and the prospect for the development of acupuncture in the 21st century will be the realisation of the internationalisation and modernisation of acupuncture. The main symbol of modernisation is the formation of modern acupuncture that maintains the theoretical system of Chinese medicine and is full of modern scientific connotations. Hong Yanfei [30] and others conducted a study based on functional magnetic resonance technology and found that acupuncture at Baihui point can have an effect on specific brain regions of the organism's brain, thus exerting an anxiolytic and antidepressant effect, and in turn exerting a sleep-aiding effect. Acupuncture has a long history of treating post-stroke hemiplegia, and its efficacy has been proved by generations, but its specific mechanism of action is not clear. Yang Siyu [31] and others provided MRI technology to assist observation, and found that acupuncture can promote the reconstruction of neural synapses in the brain of patients with stroke, accelerating the recovery of brain function, and providing an important research method for revealing the mechanism of action of acupuncture in the management of stroke. Zhong Sitong [32] and others found that acupuncture for cerebral infarction works through multiple pathways and has different central mechanisms of action on motor, sensory, and cognitive dysfunction after cerebral infarction, as well as on aphasia after stroke through functional magnetic resonance technology. Based on magnetic resonance technology, Li Yu-Xin [33] and others demonstrated that acupuncture treatment for childhood autism can improve children's language, social, perceptual, and health problems, as well as the correlation between different brain regions and clinical

symptoms, through energy changes in different brain regions. Based on functional magnetic resonance technology, Ren Delin [34] and others found that acupuncture at Taixi, Taichong, Shenmen, and Neiguan acupoints could improve the abnormal activities of specific brain structures such as the cingulate gyrus and hippocampus in patients with Alzheimer's disease and improve the clinical symptoms of Alzheimer's disease. Functional magnetic resonance is closely linked to the study of acupuncture mechanisms, which is receiving more and more attention [35]. Acupuncture theory should keep up with the times and fully apply modern science and technology [36]. Let the modern high-precision imaging technology serve the research of acupuncture mechanism, constantly explore and develop the new theory of acupuncture, fully absorb the modern scientific and technological achievements in mutual cross-fertilisation, according to the characteristics of fMRI is an important means to study the motor, visual, cognitive and memory functions among the brain functions, and select from the optimal selection of some acupuncture efficacy is accurate, and the acupuncture effect exerts the effect of the above functions related to the study of the disease to avoid the blindness, and then to reduce the number of the study. This will avoid the blindness of the study and reduce the unnecessary waste of human and material resources.

7. Conclusion

With the change of demographic structure in China, acupuncture neuroimaging research will be more diversified, and its entry point will gradually change from focusing on diseases to focusing on subhealth status and post-disease rehabilitation, and the research object will be expanded from adults, which is easier to implement, to adolescents and seniors, as appropriate. At present, the theoretical research related to acupuncture, such as meridian theory, fascia theory and neuroendocrine theory and many other doctrines are mainly based on traditional Chinese medicine theory, lack of visual experimental basis. The continuous progress of modern imaging technology has, to a certain extent, contributed to the development of the acupuncture discipline: the progress of acupuncture visualisation technology, the in-depth study of the mechanism of action of acupuncture, the improvement of acupuncture imaging diagnostic technology, the individualisation and precision of acupuncture treatment. With the continuous development of modern science and technology and the constant refinement of medical imaging, ultrasound, CT, MRI and other imaging technologies have many advantages such as non-invasive, intuitive, visualisation, etc. Ultrasound is better in assisting the monitoring process, has the unique advantage of real-time dynamics, and can provide tissue morphology and biomechanical information at the same time, and its application in theoretical research on the mechanism of the therapeutic efficacy of acupuncture and the clinical research on the effect of acupuncture treatment Its application in the theoretical study of acupuncture efficacy mechanism and clinical study of acupuncture treatment effect will be more and more in-depth. In conclusion, acupuncture and moxibustion imaging has a broad development prospect, and will play an important role in many fields such as acupuncture treatment, teaching, research, etc., and contribute to the further development and wide application of acupuncture and moxibustion.

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