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针灸技术操作规范
电针

Technical benchmark of acupuncture and moxibustion—
Electroacupuncture

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Foreword

This document is developed in accordance with the technical procedures and rules established by the Standardization Working Committee of the World Federation of Acupuncture-Moxibustion Societies.

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Introduction

Electroacupuncture, a non-pharmacological treatment, has been widely used in clinical practice. Electroacupuncture therapy originates from traditional acupuncture, in which electrical stimulation parameters are applied with needling to enhance the therapeutic effect of acupuncture. This document can improve the clinical application of electroacupuncture therapy and ensure patient safety.

This document aims to provide scientific, reasonable, and safe guidance for the operation of electroacupuncture therapy, to standardize the technical parameters, and to use electroacupuncture equipment to promote the clinical application and development of electroacupuncture therapy.

The applicable scope of this document is for medical personnel, researchers, and related equipment manufacturers engaged in electroacupuncture therapy, and to promote international exchanges and cooperation in electroacupuncture therapy.

Technical benchmark of acupuncture and moxibustion—Electroacupuncture

1 Scope

This section establishes the terms and definitions, operational steps and requirements, and safety requirements of electroacupuncture.

This section is applicable to technical operation of electroacupuncture.

2 Normative references

The content of following documents constitutes an essential provision of this document by means of normative references in the text. For dated references, only the edition corresponding to that date applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

WFAS 006.7—2023, *Technical benchmark of acupuncture and moxibustion—Filiform needle*

ISO 17218, *Sterile acupuncture needles for single use*

ISO/TR 20520, *Traditional Chinese medicine—Infection control for acupuncture treatment*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
electroacupuncture

Electroacupuncture is one of the acupuncture methods which electroacupuncture apparatus output impulsive current to the certain position on human body through filiform needles on the basis of qi arrival in order to prevent and cure disease.

3.2
electroacupuncture apparatus

Electroacupuncture apparatus refer to the electronic devices which can output impulsive current.

NOTE　Electroacupuncture apparatus includes mainframe machine, electrode lines, power adapter and other accessories.

3.3
electrode wire

The electrode wires refer to the wires that output the impulsive current of electroacupuncture apparatus.

NOTE　The electrode wire is connected between the output end of the electroacupuncture apparatus and the filiform needle. Two wires are packed in a group, distinguished as positive and negative electrodes.

3.4
dispersive electrode

The dispersive electrode refers to the other electrode of the circuit, which is placed on the non-acupunctured body surface when electroacupuncture is performed on a single acupoint.

3.5
impulsive current

The impulsive current refers to the current which occurs instantaneously and changes suddenly according to a certain rule.

3.6
parameters of electroacupuncture

Parameters of electroacupuncture refer to the description of pulse pattern, pulse amplitude, pulse width, pulse frequency and pulse output mode.

3.7
continuous wave

Continuous wave is one of the combined waves output by electroacupuncture apparatus, which is simply consist of basic-pulse pattern without pause and the frequency is continuously adjustable.

3.8
dilatational wave

The frequency output by electroacupuncture apparatus is a combined wave pattern, which changes periodically and is alternated by sparse wave and dense wave.

3.9
intermittent wave

Intermittent wave refers to the periodically intermittent combined wave, which is the pulse wave sequent obtained from a continuous wave and modulated by a rectangular pulse.

3.10
pulse amplitude

Pulse amplitude refers to the difference between the maximum and minimum pulse voltage or current (Voltage peak $V_{p\text{-}p}$ or current peak $I_{p\text{-}p}$).

NOTE Pulse amplitude is represented by symbol U_m. The measuring unit is Voltage (V) or milliampere (mA).

3.11
pulse width

Pulse width refers to the duration that the pulse lasts after occurrence of it.

NOTE Pulse width is represented by symbol t_w. The measuring unit is millisecond (ms).

3.12
pulse frequency

Pulse frequency refers to the number of pulses per unit time.

NOTE Pulse frequency is represented by symbol f. The measuring unit is Hertz (Hz).

3.13
intensive of electroacupuncture

Intensive of electroacupuncture refers to the pulse energy output to human tissue per unit time.

NOTE Intensive of electroacupuncture is represented by symbol P. The measuring unit is Joule per second (J/s) or Watt (W).

4 Operation steps and rules

4.1 Preoperative preparation

4.1.1 Electroacupuncture apparatus preparation

Check the power switch, prepare the batteries for the mainframe using dry batteries, ensure sufficient electricity. Check the output electrode wire and ensure the electrical conductivity well to make sure the electroacupuncture apparatus can operate well. All knobs are set to 0 position.

4.1.2 Selection of needles for electroacupuncture

Selection of needles for electroacupuncture should conform to the regulations of ISO 17218.

4.1.3 Selection of acupoint

4.1.3.1 Selection principle

Select the acupoints and treatment sites according to the disease condition.

4.1.3.2 Selection regulation

According to the requirements of current circuit, the acupoints should be selected in pairs while 1 to 3 pairs of acupoints, namely 2 to 6 acupoints, are appropriate, when treating with a single acupoint, dispersive electrode should be used.

4.1.4 Position selection

The body position not only should be convenient for the doctor to select the acupoints accurately and operate, but also can let the patient stay comfortable and last for long. It also facilitates the proper position of the electrode wire without pulling.

4.1.5 Selection of electroacupuncture parameters

Proper electroacupuncture parameters should be selected according to the nature of disease, which should accord to the regulations of Annex A specifically.

4.1.6 Environmental requirement

Keep the treatment environment neat and clean to prevent pollution.

4.1.7 Disinfection

Needle tools, acupuncture points and doctors' hands should be strictly disinfected before acupuncture. Specific disinfection methods should be in accordance with the regulations in ISO/TR 20520. The electroacupuncture apparatus and the accessories should be disinfected if necessary.

4.2 Operation methods

4.2.1 Check before power-on

Check every output knob and button of electroacupuncture apparatus and adjust them to "zero".

4.2.2 Acupuncture

Select the acupoints and finish the operation according to the acupuncture insertion method and needling manipulation method.

4.2.3 Output connection

Insert the electrode wire plug end into the corresponding mainframe output socket and connect the two poles of the electrode wire output end to the filiform needle handles or the needle bodies respectively. When treating with single acupoint, connect one pole of the output end to the acupoint and connect the other pole to the dispersive electrode. Ensure the connection firm and conductive.

4.2.4 Power-on

Turn on the power switch of the electroacupuncture apparatus after ensuring the electricity supply.

4.2.5 Wave pattern and frequency selection

Adjust the wave pattern, frequency knob or button to select the needed wave pattern and frequency of treatment. The major parameters of pulse wave pattern mainly refer to the Annex B. The common pulse combinations refer to the Annex C. The types of medical pulse wave frequency refer to the Annex D.

4.2.6 Output intensity adjustment

Adjust the corresponding output knob or button to slowly increase the output amplitude step by step until the patient cannot endure or adjust the intensity in the scope of permission according to the regulations of instructions. To prevent the patient from feeling "electric shock", the amplitude of regulation should be slight. The measuring method of output intensity refer to the Annex E specifically.

4.2.7 Intraoperative adjustment

When it's necessary to adjust the wave pattern and frequency, must adjust the output intensity to minimum and then change the wave pattern and frequency.

4.2.8 Power-off

After the completion of electroacupuncture treatment, must slowly adjust the strength knob or button to set the output strength to zero. Turn off the power switch of electroacupuncture apparatus. Then remove the electrode wire from the needle handle (needle body).

4.2.9 Needle extraction

Finish the extraction operation according to specifications for filiform needle operation.

4.2.10 Duration of electroacupuncture therapy

Duration of electroacupuncture therapy should be decided according to the treatment condition. 15 mins to 60 mins are suitable.

4.3 Postoperative treatment

The daily maintenance and maintenance rules of the electroacupuncture apparatus refer to the product instruction.

4.4 Precautions of operation

4.4.1 Please read the product instruction carefully before using the electroacupuncture apparatus to comprehend the performance, parameters, using methods, precautions and contraindications of electroacupuncture apparatus.

4.4.2 When operating electroacupuncture near the medulla oblongata, spinal cord and other positions, the current should be small. Pay attention to the current circuit not to cross the central nervous system and avoid strong stimulation.

4.4.3 The current is not allowed to flow across heart. For example, the two acupoints located on left and right upper limb are not allowed to accept simultaneous one-way output therapy.

4.4.4 If the patient faint in the course of acupuncture treatment, the electroacupuncture apparatus should be turned off immediately and the patient should be treated as fainting during filiform acupuncture treatment.

4.4.5 During the course of electroacupuncture treatment, the operator should strictly ensure the current circuit unobstructed. Any bad contact between output end of electroacupuncture apparatus and electrode wire or electrode wire and filiform needle should not be allowed.

4.4.6 The cautions of the filiform needle treatment equally conform to electroacupuncture.

5 Safety

5.1 Contraindication

5.1.1 The inhibition scope should refer to the electroacupuncture apparatus instruction.

5.1.2 Electroacupuncture should not be used on skin lesions, local tumor, abdomen of pregnant women, near the heart, people with pacemaker and carotid sinus.

5.2 Adverse event

Refer to the 5.2 in WFAS 006.7—2023.

5.3 Qualification of practitioner

According to the laws of the country/region, the qualifications of the practitioner are limited.

Annex A
(normative)
The efficacy and the selection of electroacupuncture parameters

A.1 Pulse pattern

A.1.1 Continuous wave

The frequency of continuous wave output by most of the pulse electroacupuncture apparatus is 1 Hz to 100 Hz.

Sparse waves can cause muscle contraction, cause a strong sense of tremor, improve the tension of muscle ligaments, regulate the systolic and diastolic function of blood vessels, improve the blood circulation, promote the recovery of nerve and muscle function and have good effects on neuromuscular paralysis.

Dense wave can cause a weak sense of tremor. When treating some pain areas of body surface, sometime dense wave has immediate analgesic effects. If the dense wave last for too long, the analgesic effect will be poorer. Dense wave is usually used near operation incision. According to the properties of absolute refractory period of the nerve, when input the pulse wave with frequency higher than 1000 Hz near operation incision, the transmission of pain stimulation to the central nerve is disturbed so that it can cause better local analgesic effect. Thus, dense wave has better analgesic effect on skin cutting.

A.1.2 Dilatational wave

Dilatational wave is a combination of sparse wave and dense wave output by turn. Sparse wave and dense wave output for 1.5 s by turn so the tissue is not susceptible to have adaptive responses. Thus, dilatational wave is suitable for acupuncture anesthesia. A current that alternates in density can cause the muscle contract in rhythm, improve blood and lymphatic circulation and regulate nutrition metabolism of tissue so dilatational wave have effects on soft tissue damage, lower back fascia strain and neuromuscular paralysis disease.

A.1.3 Intermittent wave

Intermittent wave refers to the periodically intermittent combined wave, which is the pulse wave sequent obtained from a continuous wave and modulated by a rectangular pulse. This kind of pulse current can cause a strong sense of tremor and cause higher excitation on nerves and muscles than continuous wave and dilatational wave. Thus, intermittent wave has better effects on sequelae, caused by cerebrovascular accident, type-B encephalitis, poliomyelitis and so on, and muscle atrophy disease caused by peripheral neurological disease.

A.2 Frequency

Electroacupuncture with different frequencies can cause central nervous release different kinds of neurotransmitters，whose biological effects are also different. Thus，the mechanism of analgesia produced by electroacupuncture with different frequencies are also different.

A.3 Intensity

The electrical stimulation intensity required for electroacupuncture analgesia is to the degree that the patient can endure while weak stimulation leads to poor result and high stimulation is not only beyond the patient's tolerance but also bad to treatment effect.

Annex B
(informative)
The parameters of the pulse wave pattern

B.1 Pulse leading-edge time t_r

In Figure B.1, for a positive pulse, leading-edge refers to the rising edge. It refers to the duration when the pulse amplitude rises from $0.1U_m$ to $0.9U_m$ because for normal pulse wave patterns, it is hard to conclude the moment when pulse is at starting value and maximum value. However, when the pulse value reaches $0.1U_m$, the varies of pulse amplitude is more obvious so that it is easier to confirm the starting position of the pulse.

B.2 Pulse trailing-edge time t_f

In Figure B.1, because it is positive pulse, the trailing-edge refers to the falling edge. It refers to the duration when the pulse amplitude falls from $0.9U_m$ to $0.1U_m$.

B.3 Pulse width t_w

Pulse width refers to the duration when the pulse rises to $0.5U_m$ to the pulse drops to $0.5U_m$.

B.4 Pulse interval T

The interval time between two pulses is called pulse interval. The relation between pulse interval and frequency is $T=1/f$.

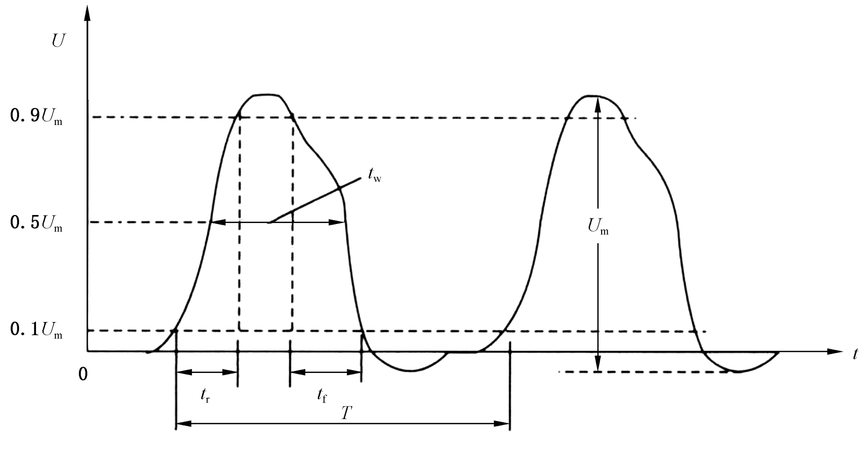

Figure B.1—The main parameters of pulse wave pattern

Annex C
(informative)
Electroacupuncture pulse combination waveform figure

Common electroacupuncture pulse combination waveforms are shown in Figures C.1 to C.4.

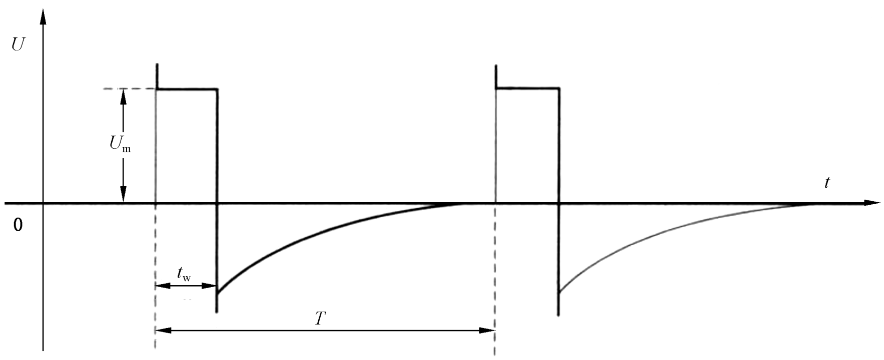

Figure C.1—Basic waveform of electroacupuncture pulse

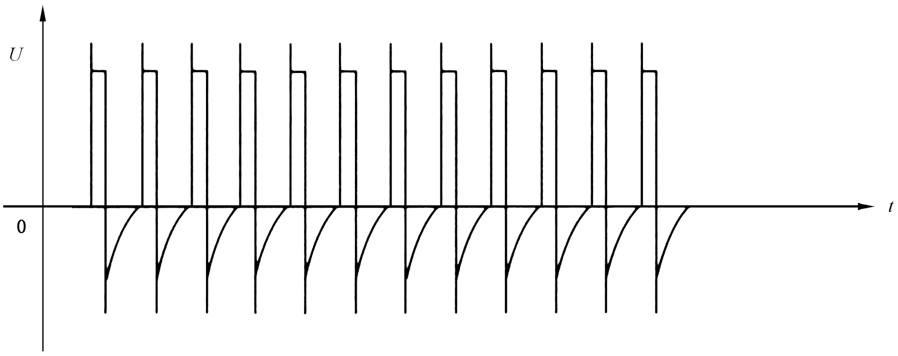

Figure C.2—Continuous wave

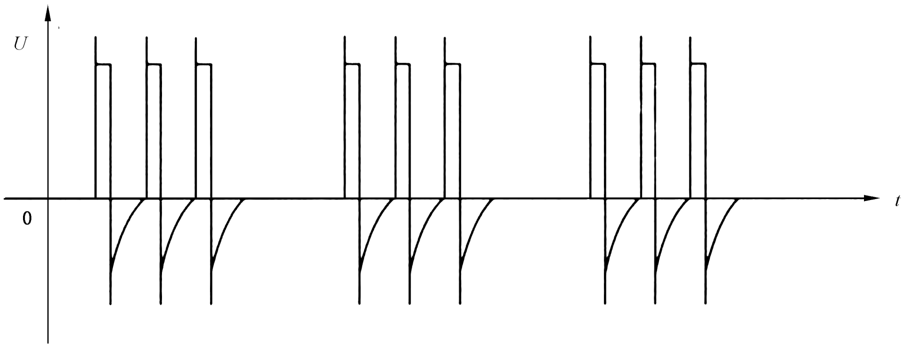

Figure C.3—Intermittent wave

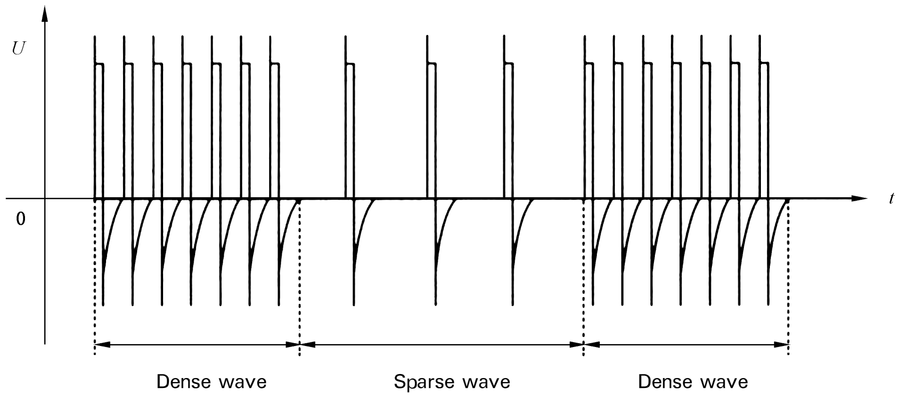

Figure C.4—Dilatational wave

Annex D
(informative)
Classification of medical pulse frequency

Regarding frequency classification, the medical division is based on physiology. The frequency range that each conduction can cause a motor nerve excitation is called low frequency. Every time a mammalian nerve is excited, there is an absolute refractory period. During this period, no matter how strong the current is, it cannot cause a second excitation. According to measurement, this period lasts about 1 ms. Therefore, to make each stimulation can cause an excitement, the electric stimulation should be given after more than 1 ms time interval. Also, the frequency should not be higher than 1 000 Hz. In this case, frequency lower than 1 000 Hz is regarded as medical low frequency range. In the frequency range of 1 000 Hz to 100 000 Hz, every stimulation cannot cause an excitation, which means multiple and continuous stimulation can cause an excitation. Medically, it is regarded as intermediate frequency. As the frequency further rise to more than 100 000 Hz, the frequency has lost its nerve stimulation, which means no matter how many stimuli combined cannot cause a single excitement because the threshold for nerve and muscle excitation was 0.03 ms to 1 ms. Thus, medically, this kind of frequency that cannot cause motor nerve excitation is regarded as high frequency. The frequency output by electroacupuncture apparatus is normally not higher than 1 000 Hz, namely in the medical low frequency range.

Annex E
(informative)
The measurement of electroacupuncture output intensity

The output intensity of electroacupuncture pulse refers to the pulse energy output to human tissues per unit time. The measuring unit is Joule per second (J/s) or Watt (W). The value is the product of the true RMS value of the output voltage and the true RMS value of the output current. True RMS is proportional to pulse frequency and pulse width. To measure single pulse energy, you should adjust the electroacupuncture apparatus to "continuous wave" with more than 20 Hz frequency, connect the current circuit as Figure E.1, use oscilloscope to capture the pulse and lock it, read out U, t_w, read out I on ammeter and calculate the energy with Formula (E.1). To measure the output intensity of pulse with stable or regular frequency, you can connect the current circuit as Figure E.2 and calculate the intensity with Formula (E.2).

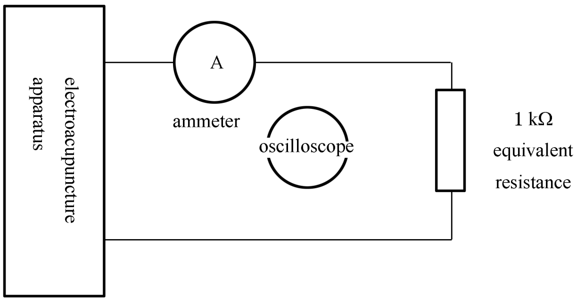

Figure E.1—Measurement of single pulse energy

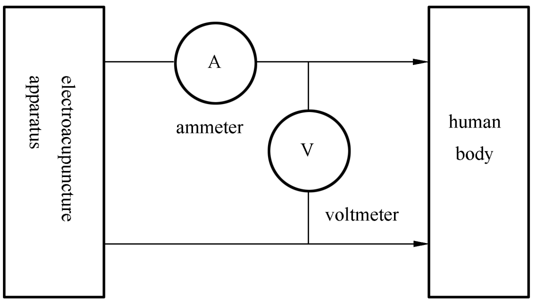

Figure E.2—Measurement of electroacupuncture output intensity

$$E = U \times I \times t_w \tag{E.1}$$

$$P = U \times I \times t_w \times f \tag{E.2}$$

where:

E single pulse energy, and the unit is Joule (J);

U true root mean square of voltage, and the unit is Voltage (V);

I true root mean square of current, and the unit is milliampere (mA);

t_w pulse width, and the unit is second (s);

P pulse output intensity of electroacupuncture, and the unit is Joule per second (J/s);

f frequency, and the unit is Hertz (Hz).

Clinically, for the convenience of measurement, when the mainframe machine voltage is stable, since the intensity is positively correlated with the voltage and current, the output intensity can be estimated by current measurement. To measure the electroacupuncture pulse current, you can connect the current circuit as Figure E.3, connect a 100 Ω resistance to the wires connecting electroacupuncture apparatus and human body as a series circuit and connect wires on both sides of the resistance to the input end of the oscilloscope. Then the fluorescent screen of oscilloscope will show the pulse wave of electroacupuncture. You can measure the pulse amplitude. Then calculate the pulse current with Ohm's law ($I = U/R$). The measured pulse current reflects the actual intensity acted on human body. It cannot be affected by external factors, so it has great advantages over voltage.

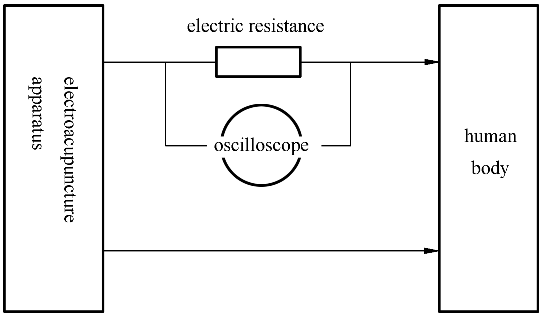

Figure E.3—Measurement of electroacupuncture pulse current

Bibliography

[1] GB/T 21709.11—2009，*Standardized manipulations of acupuncture and moxibustion—Part 11：Electroacupuncture*

[2] ISO 20487:2019，*Test method of single-use acupuncture needles for electrical stimulation*

[3] ISO 24571：2022，*General requirements for the basic safety and essential performance of electroacupuncture stimulators*

前　言

本文件依据世界针灸学会联合会标准工作委员会制定的技术流程和规则研制。

本文件由世界针灸学会联合会(World Federation of Acupuncture-Moxibustion Societies，WFAS)归口并发布。

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本文件的制定得到了中华人民共和国科技部-国家重点研发计划中医药现代化研究重点专项项目国际针灸临床实践指南、技术操作规范和服务标准的研制(项目编号:2019YFC1712200)中国际针灸技术操作规范研制(课题编号:2019YFC1712204)的基金支持。

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引　　言

电针疗法作为一种非药物治疗手段，已被广泛应用于临床实践中。电针疗法起源于传统针灸，在针刺的基础上施加电刺激参数，以增强针刺的治疗效果。本文件能够提高电针疗法的临床应用效果，保障患者的安全。

本文件旨在为电针疗法的操作提供科学、合理、安全的指导，规范电针设备的技术参数和使用方法，以促进电针疗法的临床应用和发展。

本文件的适用范围为从事电针疗法工作的医务人员、研究人员以及相关设备制造商，促进电针疗法的国际交流与合作。

针灸技术操作规范
电针

1 范围

本文件规定了电针的术语和定义、操作步骤与要求及安全性要求等。

本文件适用于电针技术操作。

2 规范性引用文件

下列文件中的内容通过文中的规范性引用而构成本文件必不可少的条款。其中，注日期的引用文件，仅该日期对应的版本适用于本文件；不注日期的引用文件，其最新版本（包括所有的修改单）适用于本文件。

WFAS 006.7—2023 针灸技术操作规范 电针

ISO 17218 一次性无菌针灸针

ISO/TR 20520 中医 针刺疗法的感染控制

3 术语和定义

下列术语和定义适用于本文件。

3.1

电针 electroacupuncture

在毫针针刺得气的基础上，应用电针仪输出脉冲电流，通过毫针作用于人体一定部位以达到防治疾病的一种针刺方法。

3.2

电针仪 electroacupuncture apparatus

能够输出脉冲电流，并满足电针治疗要求的电子仪器。

注：电针仪包括主机、电极线、电源适配器等附件。

3.3

电极线 electrode wire

电针仪输出脉冲电流的导线。

注：电极线连接于电针仪输出端与毫针之间，两条导线为一组，有正极、负极之分。

3.4

无关电极 dispersive electrode

电针单穴治疗时，置于人体非针刺体表部位的另一回路电极。

3.5

脉冲电流 impulsive current

按一定规律瞬间出现的突然变化的电流。

3.6

电针参数　parameters of electroacupuncture

电针仪输出的脉冲波形、脉冲幅度、脉冲宽度、频率、脉冲输出模式的数字描述。

3.7

连续波　continuous wave

电针仪输出的组合波之一，由基本脉冲波简单重复，中间没有停顿，频率连续可调。

3.8

疏密波　dilatational wave

电针仪输出的频率呈周期性快慢变化的组合波形，由疏波和密波交替出现。

3.9

断续波　intermittent wave

周期性时断时续的组合波，由连续波经过矩形脉冲调制后得到的脉冲波序列。

3.10

脉冲幅度　pulse amplitude

脉冲电压或电流的最大值与最小值之差（电压峰峰值 $V_{P\text{-}P}$ 或电流峰峰值 $I_{P\text{-}P}$）。

注：脉冲幅度用符号 U_m 表示，单位为伏特（V）或毫安（mA）。

3.11

脉冲宽度　pulse width

脉冲出现后所持续的时间。

注：脉冲宽度用符号 t_w 表示，单位为毫秒（ms）。

3.12

脉冲频率　pulse frequency

单位时间内脉冲出现的个数。

注：脉冲频率用符号 f 表示，单位为赫兹（Hz）。

3.13

输出强度　intensive of electroacupuncture

单位时间内输出给人体组织的脉冲能量。

注：输出强度用符号 P 表示，单位为焦每秒（J/s）或瓦（W）。

4　操作步骤与要求

4.1　操作前准备

4.1.1　电针仪准备

检查电源开关，使用干电池的主机应备好电池，并确保电量充足；检查输出电极线，并保证导电性能良好，应确保电针仪正常工作，所有旋钮均调至"零"位。

4.1.2　针具选择

针具选择应符合 ISO 17218 的相关规定。

4.1.3　腧穴选择

4.1.3.1　选择原则

根据病症选取适当的腧穴或治疗部位。

4.1.3.2 选择规律

按电流回路要求，选穴宜成对，以1对～3对(2个～6个穴位)为宜；当选择单个腧穴进行治疗时，应使用无关电极。

4.1.4 体位选择

应选择便于施术者正确取穴，方便操作；病人肢体舒适，能持久；同时有利于电极线无牵拉的合适位置。

4.1.5 电针参数选择

应根据疾病的性质选取合适的电针参数，具体规定见附录A。

4.1.6 环境要求

应保持治疗环境清洁卫生，防止污染。

4.1.7 消毒要求

毫针针刺前应对针具、针刺穴位和医生双手进行严格消毒，具体的消毒方法应符合ISO/TR 20520消毒部分的相关规定。必要时，电针仪及附件也应进行消毒。

4.2 操作方法

4.2.1 开机前检查

检查电针仪各输出旋钮或按键并调整到“零”位。

4.2.2 针刺

选取穴位，按毫针进针和行针方法完成操作。

4.2.3 仪器连接

将电极线插头端插入相应的主机输出插孔，电极线输出端两极分别连接于毫针针柄或针体，当单穴治疗时，电极线输出端一极接穴位，另一极接无关电极。应确保电极线连接牢靠、导电良好。

4.2.4 仪器开机

在确保供电之后打开电针仪电源开关。

4.2.5 波形、频率选择

调节波形、频率旋钮或按键，选择治疗所需的波形、频率。脉冲波形的主要参数见附录B，常见电针脉冲组合波形见附录C，医用脉冲频率分类见附录D。

4.2.6 输出强度调节

调节对应输出旋钮或按键，逐级、缓慢增加输出幅度，以病人可耐受为度，或根据使用说明书的规定，在许可的范围内调节强度。调节时为了防止受术者产生“电震”感，调节的幅度应小。电针输出强度的测量见附录E。

4.2.7 术中调整

有必要在电针治疗过程中对波形、频率进行调整时，应首先调节输出强度至最小，然后再变换波形

和频率。

4.2.8 关机

电针治疗完成后，应首先缓慢调节强度旋钮或按键，使输出强度置零位，关闭电针仪电源开关，然后从针柄（针体）取下电极线。

4.2.9 出针

按毫针操作规范要求进行出针操作。

4.2.10 电针治疗持续时间

根据病情决定，宜在 15 min～60 min 之间。

4.3 操作后处理

电针仪的日常保养和维护规则参考产品使用说明书。

4.4 操作注意事项

4.4.1 在首次使用电针仪前，应仔细阅读产品使用说明书，掌握电针仪的性能、参数、使用方法、注意事项及禁忌症等内容。

4.4.2 靠近延脑、脊髓等部位使用电针时，电流量宜小，并注意电流的回路不应横跨中枢神经系统，刺激不可过强。

4.4.3 禁止电流直接流过心脏，如不允许左右上肢的两个穴位同时接受一路输出治疗。

4.4.4 电针治疗过程中病人出现晕针现象时，应立即停止电针治疗，关闭电源，按毫针晕针的处理方法处理。

4.4.5 电针治疗过程中应严格确保每组输出电流回路通畅，不允许电针仪输出端与电极线、电极线与毫针之间产生任何接触不良现象。

4.4.6 使用毫针的注意事项，同样适用于电针。

5 安全性要求

5.1 禁忌

5.1.1 禁忌范围应参照电针仪使用说明书。

5.1.2 皮肤破损处、肿瘤局部、孕妇腹部、心脏附近、安装心脏起搏器者、颈动脉窦附近禁忌电针。

5.2 不良事件

按照 WFAS 006.7—2023 中 5.2 的规定执行。

5.3 操作者资质

操作者资质应符合各国家及地区对针灸操作人员资格限定的要求。

附　录　A
（规范性）
电针不同参数的效应与选择

A.1　波形

A.1.1　连续波

多数脉冲电针仪输出的连续波的频率为 1 Hz～100 Hz。

疏波可引起肌肉收缩，产生较强的震颤感，提高肌肉韧带的张力，调节血管的舒缩功能，改善血液循环，促进神经肌肉功能的恢复，对神经肌肉瘫痪性疾病有良好的效果。

密波震颤感弱，作用体表某些疼痛区，能有某些即时镇痛效果，但易出现适应性反应，时间过久镇痛效果则较差。密波常用于手术切口旁，根据神经绝对不应期的特性，频率高于 1 000 Hz 的电脉冲输入置于手术切口周围，干扰了痛刺激向中枢的传递，可引起较好的局部止痛效果，故对切皮镇痛效果较好。

A.1.2　疏密波

疏密波是疏波和密波轮流输出的组合波，疏密交替持续的时间各约 1.5 s，对组织不易出现适应性反应，因此常被针麻选用。疏密交替出现的电流，能引起肌肉有节奏地舒缩，加强血液循环和淋巴循环，调节组织的营养代谢，对一些软组织损伤、腰背筋膜劳损，以及一些神经肌肉麻痹等疾病有一定的疗效。

A.1.3　断续波

断续波为有节律的时断时续的组合波，即将连续波经过矩形脉冲调制后得到的脉冲波序列。交替输出的这种脉冲电流对人体有强烈的震颤感，对神经肌肉的兴奋较连续波和疏密波的作用更强，对脑血管意外、乙型脑炎、小儿麻痹症等出现的后遗症和一些周围神经病变引起的肌肉萎缩性疾病，有较好的效果。

A.2　频率

不同频率的电针可引起中枢释放不同种类的神经介质，其生物效应亦不相同，不同频率的电针产生的镇痛作用的机制也有所不同。

A.3　强度

电针镇痛所需的电刺激强度，一般以能最大耐受为度，过弱效果不佳，过强病人不能耐受，也不利于提高针效。

附 录 B
（资料性）
脉冲波形的主要参数

B.1 脉冲前沿时间 t_r

图 B.1 中，对正脉冲而言，前沿即指上升沿。它是指脉冲幅度从 $0.1U_m$ 上升到 $0.9U_m$ 所对应的时间。因为对一般的脉冲波形很难断定脉冲的起始值和最大值的时刻，而到了 $0.1U_m$ 时，幅度的变化就比较明显，容易确定脉冲的起始位置，故做这样的规定。

B.2 脉冲后沿时间 t_f

图 B.1 中，因是正脉冲，后沿即指下降沿。它是指从脉冲幅度 $0.9U_m$ 下降到 $0.1U_m$ 的所对应的时间。

B.3 脉冲宽度 t_w

脉冲宽度指脉冲上升到 $0.5U_m$ 至脉冲下降到 $0.5U_m$ 所对应的时间。

B.4 脉冲周期 T

相邻两个脉冲之间的间隔时间称为脉冲周期。它与频率之间的关系为 $T=1/f$。

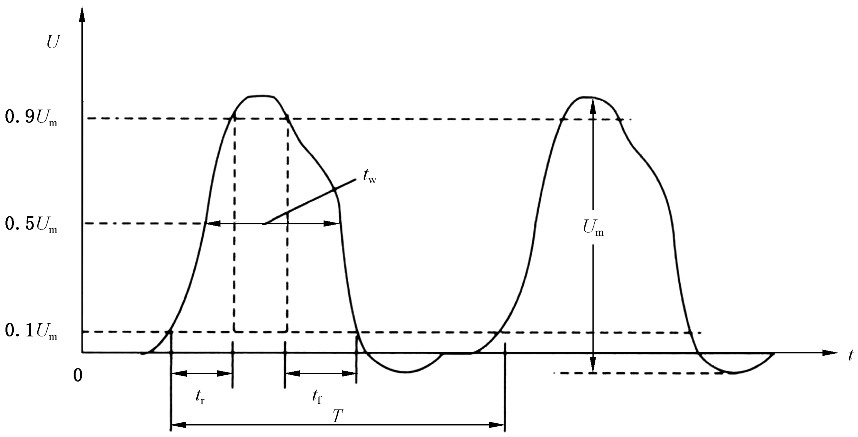

图 B.1 脉冲波形的主要参数

附 录 C
（资料性）
常见电针脉冲组合波形图

常见电针脉冲组合波形见图 C.1～图 C.4。

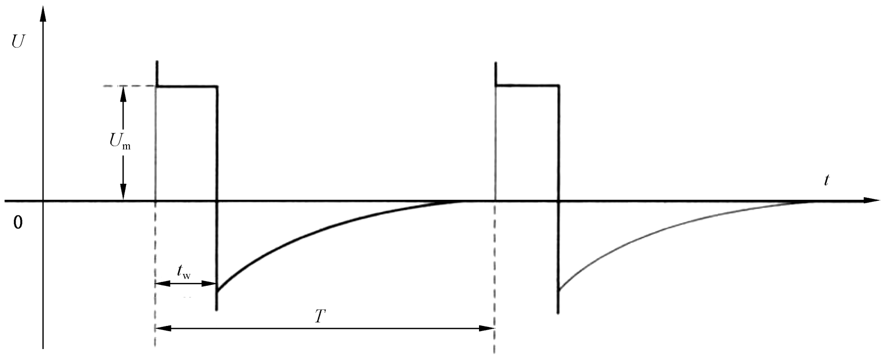

图 C.1 电针脉冲基本波形

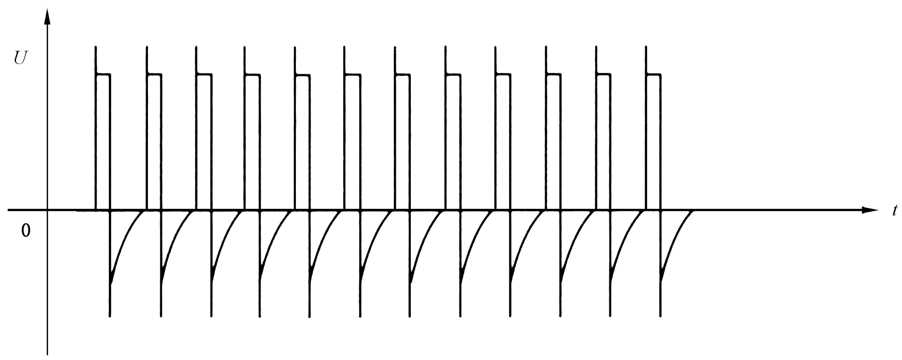

图 C.2 连续波

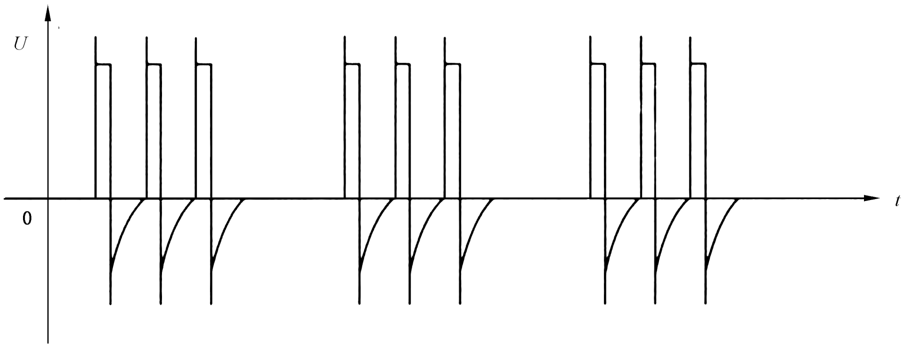

图 C.3 断续波

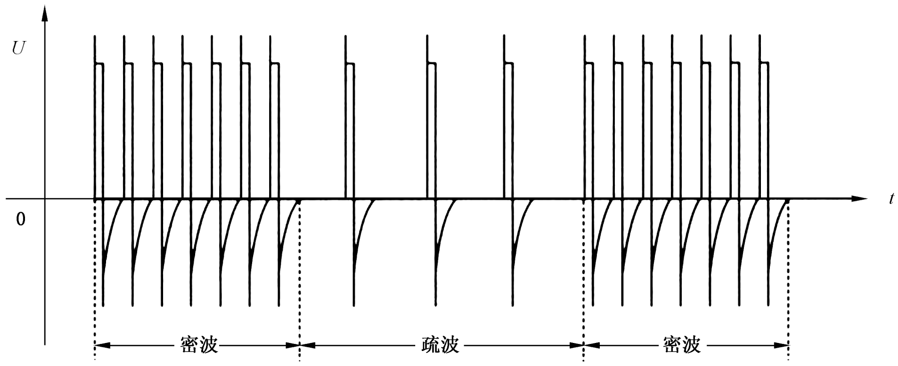

图 C.4 疏密波

附　录　D
（资料性）
医用脉冲频率分类

关于频率分类问题，医学上是根据生理学来划分的。每一次通电都能使运动神经发生一次兴奋的频率范围，称为低频。哺乳类动物神经每次兴奋后，都有一个绝对不应期。在此期间内无论电流强度多大，也不能引起第二次兴奋。据测定，此期间约持续 1 ms。因此，要使每一个刺激都能引起一次兴奋，电刺激就应相隔 1 ms 以上才能再给一次，亦即频率不大于 1 000 Hz。这样把 1 000 Hz 以下频率定为医用低频范围。在 1 000 Hz～100 000 Hz 范围内，每次刺激已不能引起一次兴奋，尚需综合多个刺激的连续作用才能引起一次兴奋，医学上把这一频率范围定为中频。当频率进一步上升，超过 100 000 Hz 时，已失去对神经的刺激作用，此时无论综合多少个刺激也不能引起一次兴奋，因为引起神经和肌肉兴奋的阈值为 0.03 ms～1 ms。所以，医学上把这种不能引起运动神经兴奋的范围定为高频。电针仪输出的频率，一般不大于 1 000 Hz ，即在医用低频范围。

附 录 E
（资料性）
电针输出强度的测量

电针脉冲输出强度是指单位时间内输出给人体组织的脉冲能量，单位为焦每秒(J/s)或瓦(W)，其值为输出电压的真有效值和输出电流的真有效值的乘积;真有效值与脉冲频率、脉冲宽度成正比关系，单个脉冲能量的测量，将电针仪调整到“连续波”，频率 20 Hz 以上，强度置最大，采用图 E.1 连接电路，示波器捕捉脉冲并锁定，读出 U、t_w，电流表读出 I，用公式(E.1)计算。频率稳定或规律的脉冲输出强度的测量，可用图 E.2 方式连接电路，结合公式(E.2)计算输出强度。

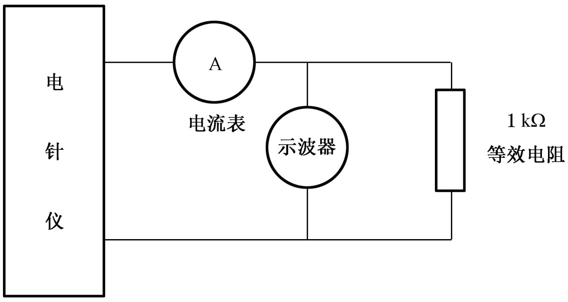

图 E.1 单个脉冲能量的测量

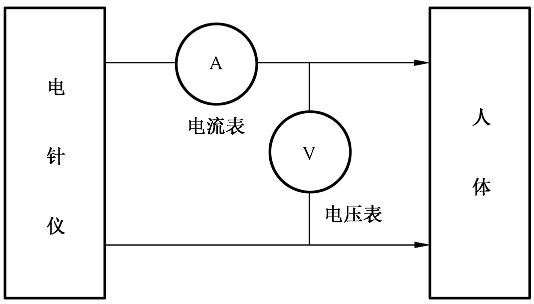

图 E.2 电针输出强度的测量

$$E = U \times I \times t_w \quad \cdots\cdots (E.1)$$

$$P = U \times I \times t_w \times f \quad \cdots\cdots (E.2)$$

式中：

E ——单个脉冲能量,单位为焦(J)；

U ——电压真有效值,单位为伏(V)；

I ——电流真有效值,单位为毫安(mA)；

t_w——脉冲宽度,单位为秒(s)；

P ——电针脉冲输出强度,单位为焦每秒(J/s)；

f ——频率,单位为赫兹（Hz)。

临床上为了便于测量，在主机电压稳定时，由于强度与电压、电流正相关，可通过电流测量来估算输出强度的大小。电针脉冲电流的测量用图 E.3 方式连接电路，在电针仪接至人体的导线中串联一只 100 Ω 的电阻，电阻的两端各引一导线接至示波器输入端。这样在示波器荧光屏上即可显示出电针的脉冲波，测量脉冲的幅度，然后根据欧姆定律（$I=U/R$），即可算出脉冲电流。测量出的脉冲电流，反映了电针仪作用到人体的实际刺激强度，它不受各种外在因素的影响，较之电压有很大的优越性。

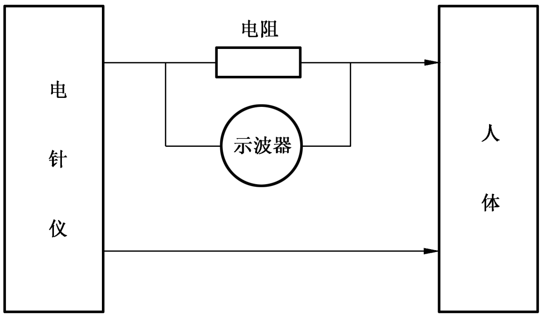

图 E.3　电针脉冲电流的测量

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［2］ ISO 20487:2019 电刺激用一次性针灸针的测试方法
［3］ ISO 24571：2022 电针刺激仪安全使用和基本性能的总体要求