Quantitative Measurement of Brain State and Neurofeedback Intervention Techniques for the Treatment of Perioperative Neurocognitive Disorders in Elderly Patients

(NCT ID: not yet assigned; Document date:2024-4-3)

INFORMED CONSENT FORM

Application Unit: National Cancer Center/National Clinical Research Center for Cancer/Cancer Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College

Principal Investigator: Hui Zheng

Dear Subject:

We are inviting you to participate in a clinical study: Quantitative Measurement of Brain State and Neurofeedback Intervention Techniques for the Treatment of Perioperative Neurocognitive Disorders in Elderly Patients. It is important for you to understand this study before you decide whether or not to participate. Please read the following information carefully so you can discuss your decision with friends and family. If you have learnt more about this study, have no more questions, and decide to take part in this study, you will need to sign this informed consent form.

Ⅰ. Introduction

1. Nature of the study: This study was initiated by the National Cancer Center/Cancer Hospital of Peking Union Medical College of the Chinese Academy of Medical Sciences (hereinafter referred to as: Cancer Hospital of the Chinese Academy of Medical Sciences), and organised by the Department of Anaesthesiology of the hospital in conjunction with the Department of Anaesthesiology of the Beijing Chaoyang Hospital and the Xuanwu Hospital of the Beijing Academy of Medical Sciences.、

2. Perioperative neurocognitive disorders (PND) have a prevalence rate of up to 40% in elderly surgical patients and are closely related to the decline in patients' postoperative quality of life, long-term cognitive impairment, and an increase in one-year postoperative mortality, and PND encompasses aspects of postoperative delirium (postoperative delirium (POD) and delayed neurocognitive recovery (DNR). In addition to the relative lack of diagnostic techniques, research in the field of PND prevention and treatment has also reached a bottleneck, and no clinical interventions have been found to effectively improve PND. It has been found that improving the basic cognitive reserve of elderly patients through interventions of different intensities, durations and techniques may have positive significance in the prevention and treatment of PND. An

observational study of elderly orthopaedic surgery patients found that encouraging patients to read, sing and write emails before surgery reduced the incidence of PND. A study also confirmed that using a special mobile phone APP to receive 10 hours of "brain exercise" (cognitive rehabilitation training) before surgery can effectively reduce the incidence of postoperative delirium in elderly patients undergoing non-cardiac major surgery. Currently, domestic and international research on "cognitive rehabilitation training" is in its infancy and lacks uniform training tools and assessment methods, but its value in improving perioperative brain health in elderly patients is worth exploring in depth. The principle of quantitative brain state measurement technology is to use multiple biomedical sensors to amplify and filter biomedical signals through a signal acquisition system, convert them into analogue electrical signals of a certain amplitude, and convert them into digital signals suitable for computer processing through an A/D converter. Relying on patented algorithms, we dynamically analyse cortical and subcortical brain electricity and use the latest wavelet algorithms in signal processing algorithms to extract and quantify data related to emotional stress, brain habits, brain development, brain capacity, etc., in order to understand the emotional state of the subjects, clarify their brain habits, and assess their brain capacity. In terms of neurofeedback

intervention training, we collect physiological data of brain electrical activity in the cerebral cortex through the use of EEG signal acquisition terminals, and extract quantitative values reflecting a variety of specific states of the brain, such as excitation, inhibition, concentration, relaxation, energy consumption, etc., which are then transformed into the corresponding commands in the brain-controlled game, guiding the user to focus on their attention and proactively adjusting their own state. The core of the game is to apply time-varying stimuli under the condition of immediate quantitative reflection of the brain's functional state, so that the brain understands the process of its own state change in real time, and thus learns the explicit regulation of the brain's inhibition and excitation through the brain's self-adaptation and learning ability. Through training, subjects will learn to regulate the brain thinking according to the needs (fast relaxation, continuous relaxation; fast concentration, continuous concentration), reduce irrational chaotic thinking, achieve the purpose of deep brain learning, and then ease the state of tension and anxiety, reduce brain fatigue, improve microcirculation, and gradually restore the brain capacity. Based on previous studies, in order to further explore the role of cognitive rehabilitation training in reducing the incidence of perioperative PND, improving perioperative brain health, and accelerating postoperative

recovery in elderly oncology patients, we will conduct a randomised, controlled clinical trial of APP-based (Quantitative Brain State Measurement and Neurofeedback Intervention Technique) cognitive rehabilitation training in improving perioperative brain health in elderly patients.

3. This study has been approved by the Ethics Committee of the Cancer Hospital of the Chinese Academy of Medical Sciences, which is an organisation that protects the rights and interests of subjects.

II. Purpose of the study

1. Main research objectives/endpoint indicators:

1.1 To clarify whether APP-based (Quantitative Brain State Measurement and Neurofeedback Intervention Technique) cognitive rehabilitation training can reduce the incidence of perioperative POD in elderly oncology patients;

2.Secondary research aims/endpoint indicators:

2.1 to clarify whether this cognitive rehabilitation training can accelerate the postoperative recovery of elderly oncology patients;

3, Exploratory research aim/endpoint indicator:

3.1 To depict the brain state characteristics of PND patients based on the results of quantitative brain state testing.

III. Research Design

1.Study population: a total of 390 patients with similar diseases as

yours will be included in this study to participate, all of them are from elderly patients who are going to undergo elective surgery at the Cancer Hospital of the Chinese Academy of Medical Sciences/Beijing Chaoyang Hospital/Beijing Xuanwu Hospital; the main inclusion and exclusion criteria are as follows:

Inclusion criteria:

1) Patients undergoing elective major surgery under general anaesthesia for colorectal, pancreatic-gastric, hepatobiliary, thoracic, gynaecological and urological procedures;

2) Expected duration of surgery > 2 hours;

(3) Age ⩾ 65 years;

Exclusion criteria:

1) Refusal to participate in this study;

2) Preoperative Brief Mental State Examination score <26 or if the patient's educational level was below high school, MMSE <24 and active depressive state (GDS-15 score >9);

3) Undergoing neurosurgery or the surgery itself interfering with the patient's postoperative communication (e.g., tracheotomy);

4) Severe organ dysfunction;

(5) Undergoing cardiac surgery or neurosurgery;

(6) ASA grade IV or above.

2. This study was a randomised, controlled clinical trial in which

subjects were screened according to the inclusion and exclusion criteria and randomly grouped into the following two groups on a 1:1 basis: control group (n=195) and intervention group (n=195).

IV. Research Steps

1. Treatment

If you voluntarily participate in this study, you are required to receive the appropriate treatment in strict accordance with the study protocol under the guidance of the study doctor or his/her team; when you have questions about the treatment, please ask your study doctor.

1.1 Trial Group:

After you have been enrolled in the study, two weeks prior to surgery, your anaesthesiologist will assess your brain status: this will include a neuropsychiatric examination using the State-Trait Anxiety (STAI) questionnaire, the Pittsburgh Sleep Quality Index (PSQI) scale, the Montreal State of Cognitive Abstracts (MoCA) scale, and completion of a baseline brain functional status test; you will then be issued with a wearable headband Subsequently, you will be given a wearable headband and a terminal device, and you will be given preoperative cognitive rehabilitation training according to the method of use (at least 1 hour per day is recommended, with a cumulative total of 14 hours of preoperative use); one day before

anaesthesia is administered, you will be examined again with the scales and tested for your brain function; on the day of the surgery, you will be anaesthetised and anaesthesia and surgical procedures will be recorded, as well as monitoring of the cardioplegia, blood pressure, respiratory rate, and the depth of sedation. On the day of surgery, we will administer the anaesthesia and record the anaesthesia and surgery, and monitor the cardiovascular, blood pressure, respiration, depth of sedation, etc. We will not interfere with the surgical operation or the anaesthesia to ensure that the surgery goes smoothly; after the surgery, you will be admitted to the anaesthesia recovery room (PACU) for observation, and after the operation, you will be given an intravenous self-contained analgesic pump to assist in the analgesia after operation. Brain status test will be performed at a fixed time to assess the incidence of POD within 7 days, and cognitive function tests will be performed on the 7th and 30th postoperative days.

1.2 Control group:

The control group was the same as the experimental group except that no cognitive rehabilitation training was performed.

2. Follow-up visits

You will be asked to complete follow-up visits until the end of the study as required by the study protocol. The purpose of the follow-

up visits is to find out how well your treatment is working, whether you are experiencing any adverse effects, and to treat you accordingly. We will follow up with you within 7 days after surgery and on the 30th day after surgery. Your doctor will arrange for you to be seen during the follow-up visits:

(1) Medical history taking

(2) Cognitive function assessment, delirium assessment

(3) Brain state measurements

(4) Assessment of pain scores

Your doctor may also recommend additional tests as needed for your condition.

V. Alternative Treatment

Participation in this study is completely voluntary, and if you do not participate, or if you choose to withdraw at any stage of the study, you will receive alternative treatments. You can discuss specific alternative treatments with your doctor before deciding whether or not to participate in this study.

VI.Possible Risks

The cognitive rehabilitation training used in this study does not involve any new drugs or techniques that are not approved in the validation phase and therefore do not increase surgical or anaesthetic risks. Due to the increased questioning of patients'

history during the study and postoperative telephone follow-up of patients, etc., patients' rest may be disturbed. In addition, due to the use of wearable headbands and APP during the study, adverse reactions that have not yet been identified or cannot be predicted may occur, including but not limited to the following risks:

1. minor skin sensitisation to the headband;

2. discomfort with the use of the APP, anxiety, nervousness, nausea and vomiting, and other uncomfortable reactions.

VII. Possible Benefits

During your participation in the clinical study, the anaesthesiologist will pay close attention to your postoperative recovery, and you will receive perfect postoperative follow-up and management. By participating in this clinical study, your disease may be relieved, but there is also a possibility that the expected results may not be achieved, or even increase the health burden due to adverse reactions. However, your participation will help medicine to further study and understand such diseases, and improve the diagnosis and treatment of the disease in the future. We would like to express our gratitude for your ability to participate in scientific research and contribute to the development of medicine!

VIII. Research Costs

The wearable headband and APP applied in this study have been

approved by the state, and the related tests are also routine tests that have been used in clinical applications for many years. This study will provide you with free cognitive rehabilitation training, pain, anxiety, and postoperative complication assessment, while other medication and diagnosis and treatment costs need to be borne by you.

IX. Handling of Damage

If you have a serious adverse reaction during the study, your doctor will examine you and give you symptomatic treatment; if you cannot tolerate the cognitive rehabilitation training or do not follow your doctor's instructions, your doctor will advise you to withdraw from the study.

X. Voluntary

Participation in this study is completely voluntary. You may withdraw from the study at any time without a reason, and your non-participation or withdrawal from the study will not affect your relationship with the medical staff or the diagnosis and treatment of your illness. If you decide to participate in this study, your doctor will inform you during the study of any information that may affect your physical condition or your decision to continue participating in the study.

XI. Principles of Privacy and Confidentiality

Your information and medical data in this study will be kept confidential to the extent required by law. We will use personally identifiable information de-identified processing to protect your privacy: you use the project uniform number after enrolment, your personal information and medical data will be collected by your doctor or his/her research team, the data will be coded, stored and protected, and the user will see only the individual number and will no longer have access to your name and other information. You have the right to enquire at any time about the content of the information recorded and to have errors corrected.

Your data will be analysed by your study doctor and additional data may be further collected from your medical records as required for this study. At any time during or after the study, to the extent permitted by law, members of the Ethics Committee or government regulatory authorities with the appropriate permissions may have access to your personal data in order to verify the truthfulness, accuracy and reliability of the study data. The results of the study are published in the form of statistically analysed data without any identifiable patient information.

XII. Termination of the study

While participating in the study, you may withdraw from the study at any time without a reason, and your decision will not have any effect

on your continued medical treatment. Your doctor may also stop your study treatment for the following reasons:

You are not receiving cognitive rehabilitation as directed and required by your study doctor.

The disease progresses or an intolerable adverse reaction occurs, and the study doctor believes that continued participation in the study would be harmful to you.

You receive treatment that is not permitted under this study.

The study doctor, ethics committee, or government regulatory agency asks to stop this study.

When you withdraw from the study or the study is terminated, the study doctor will discuss subsequent treatment with you.

XIII. Enquiries about the study

If you personally have any questions about this study, you may contact Dr Hui Zheng at the Cancer Hospital of the Chinese Academy of Medical Sciences directly at 010-87788256. If you have any questions related to the rights of the subjects, or would like to reflect difficulties, dissatisfaction, and concerns encountered in the course of participating in the study, or would like to provide comments and suggestions related to the study, please contact the Cancer Hospital of the Chinese Academy of Medical Sciences Ethics Committee, Tel: 010-87788495, E-mail: cancergcp@163.com.

Quantitative Measurement of Brain State and Neurofeedback Intervention Techniques for the Treatment of Perioperative Neurocognitive Disorders in Elderly Patients

Signature page of informed consent form

Subject's statement

The research doctor has explained to me in detail the purpose of the study, the process, and the possible risks and benefits of participating in the study; I have read the informed consent form carefully, all questions have been answered to my satisfaction, and I have understood it all.

I consent to the collection and use of my medical information by my study doctor. I give my consent to the Cancer Hospital of the Chinese Academy of Medical Sciences to access my medical information and findings in this study for scientific research purposes. I consent to the members of the Ethics Committee and the representatives of the governmental administration to access my medical data with the appropriate permissions, subject to the principle of confidentiality, and I understand that the purpose of reviewing these records is to ensure that the information collected from this study is true, complete and reliable.

I understand that my participation in this study is voluntary, that I

may withdraw from the study at any time and that it will not affect my subsequent medical treatment or legal rights.

I have been given a copy of the signed informed consent form. By signing this consent form, I am not waiving any of my legal rights.

Patient Signature _____ Date_____

Signature of legal representative*_____ Date_____

Relationship with the patient_____

* The signature of a legal representative is not required unless the subject is unable to read (e.g., illiterate or blind) or is otherwise unable to sign for himself/herself.

Investigator's statement

I promise to strictly abide by the principles of GCP, comply with the relevant regulations of the State and the Cancer Hospital of the Chinese Academy of Medical Sciences, protect the rights and interests of the subjects, and ensure that the working time of the study and the data of the study are true, complete, and reliable during the clinical study. I agree that the Cancer Hospital of the Chinese Academy of Medical Sciences may access the medical data and research results of this study for scientific research purposes.

I have fully explained to the patient the purpose and process of

this study, as well as the possible risks and benefits of participating in the study, and the patient has been provided with sufficient information to make the decision to participate in this study. I will provide the patient or his/her legal representative with a signed and dated copy of the informed consent form.

Investigator Signature _____ Date_____

Investigator Contacts __010-87788256_____