Research on intelligent management of pain

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Abstract. Pain affects patients' quality of life. With the acceleration of modern life and the advent of aging society, the incidence of pain keeps rising, becoming one of the important health issues concerned by the whole world. Invention of an intelligent pain management device is necessary in pain management. Combined with clinical data, the mechanism of the intelligent pain management system in cancer pain patients is provided, and how to improve the treatment effect of cancer pain is discussed in this paper.

1. Introduction

As one of the most common clinical symptoms, pain is the fifth vital sign of the disease. Chronic pain is a kind of disease, which seriously affects one’s quality of life and quality of working. Relieving pain has long been the goal of medical research [1]. In October, 2004, the international association for the study of pain (IASP) proposed to set the third week of October every year as "Global Day Against pain". It became the focus of the year and the most remarkable event of the Global pain medicine. The quality of pain management has also become one of the standards to measure the quality of medical care. The former ministry of health first included the "management of pain treatment and continuous improvement" in the "evaluation standards for general hospitals (2011 edition)".

In the 1940s, it already had specialized pain treatment the United States. John Bonica et al. recognized the complexity of pain [2]. It requires a comprehensive treatment, including biological, psychological and social disciplines. As an important part of computer science, artificial intelligence has always been at the forefront of computer technology, known as one of the three most advanced technologies in the world (space technology, energy technology, artificial intelligence) [3]. With the rapid development of science and technology, along with the further research and development of artificial intelligence, more and more intelligent machines emerge in the human's life, and play a more and more important role. The application of artificial intelligence to the diagnosis and treatment of pain is a big achievement. The intelligent management of pain solves many problems in the pain clinic and brings the Gospel for patients suffering pain.

2. Definition and Harmness of Pain

2.1. Definition of pain

In 1979, IASP defined pain as: pain is an uncomfortable subjective feeling and emotional experience produced by the human brain related to actual or potential tissue damage. In 2016, it was updated as follows: pain is a kind of painful experience on feeling, emotion, cognition and social level caused by actual or potential tissue damage [4]. There are various ways to classify pain. The five-axis
classification adopted by world pain society is accepted by most doctors. It includes the location, type and characteristics, time duration and intensity, system and cause of pain.

2.2. Harmness of pain
Pain itself is a protective mechanism for the body in order to respond defensively to harmful stimuli for the body, but excessive pain is a detriment. It brings a lot of pain to the individual, family, as well as society. For individuals, pain not only brings physical and mental effects to patients, but also has adverse effects on the central nervous system, endocrine system, circulation system, respiratory system, digestive system and autonomic nervous system, even leading to pathological changes and seriously affecting patients' normal life.

3. Intelligent Management of Pain
Intelligent control refers to the process that drives functional machines to achieve their goals autonomously without direct human intervention. Pain treatment methods and research have been carried out in a variety of ways and have achieved great success compared to the past. However, according to the data of the international health agency, only about 15% of patients with pain can receive reasonable treatment, and more patients' quality of life is seriously affected, becoming the most important cause of pain, distress and disability. Especially for cancer patients, according to limited statistics, there are more than a third of cancer patients suffering the torture of moderate to severe pain in the world [5]. Compared with widely use and appreciation of opioids patients in the developed countries, patients in the developing countries do not follow medical advice to take pain medications and have misconceptions about pain treatment and opioid use [6]. At the same time, doctors can’t standardize the implementation of medical advice and ensure the best treatment effect of patients, due to the lack of effective tools for real-time evaluation and follow-up of the pain drug efficacy [7].

3.1. Fuzzy reasoning and neural network in intelligent control
Intelligent control has three goals: safety, economy and comfort. Intelligent control is to study and make use of some structure mechanism of human brain, human knowledge and experience to control the system. Using neural network, the control problem can be regarded as the problem of mode recognition, and the process of identifying mode is to change mapped signal to the behavior signal. It is generally believed that neural network control system is more intelligent and can deal with the control problems of complicated processes with high dimensions, nonlinearity, strong coupling and uncertainty. It is characterized by learning ability, constant modification of the connection values between elements, and discrete storage, so it has good mapping ability for non-linear system and hard-to-model system. The correction of the weight can be viewed as a modification of the map to achieve the desired objective function [8].

The fuzzy reasoning and neural network applied in intelligent control have different characteristics. Generally speaking, fuzzy control is rule-based reasoning. If you have enough knowledge of system control, you can control well. However, the neural network needs a large number of data learning samples. If the system has enough learning samples that are traversed in each state, the neural network can get a satisfactory control through learning, and can continuously learn in the control to correct the connection weight. The neural network control regards the system control problem as the mapping problem of "black box", which lacks clear physical meaning, so the qualitative knowledge of control experience is not easy to integrate into the control. Therefore, fuzzy logic is easy to express people's control experience and other qualitative knowledge, while neural network has strong learning ability in using systematic quantitative data [9, 10].

The intelligent management system of pain is simply the application software of the phone, which generally includes the functions of life condition assessment, pain score, medication remind, health education and so on. Among them, life status assessment mainly combines the internationally accepted patient quality of life rating scales (KPS) and QOL scale to evaluate patients' quality of life. The pain score is generally NRS, and the action plan is made to see a doctor or adjust the dose of analgesics when the pain threshold is reached. Health education generally includes pain related knowledge.
Patients can receive NRS, KPS and QOL scores on their mobile phones. The system can intelligently adjust the treatment plan for patients and remind patients to take medicine and assess them through the device. At the same time, medical professionals in the system update medical knowledge related to the individual patient. Doctors can also learn the conditions and treatment of patients and guide them remotely. (Figure 1)

![Mechanism of intelligent analgesic device](image)

**Figure 1.** Mechanism of intelligent analgesic device

### 3.2. The combination with medicine

First of all, big data should be established by collecting health related information through multiple channels, such as through regional medical cooperation service information platform for the patient's diagnosis and treatment information (health records, electronic medical records, all previous visits, advice inspection results, etc.). Physical signs of patients can be obtained through wearable devices. At the same time, through the network technology, climate and environment information are collected. Through analysis and mining of these large data, the health status of patients with cardiovascular diseases is assessed, on the base of the relevant knowledge (library, literature, guidelines, etc.). The intelligent formation of the patient's health has early warning model. According to the intelligent health model of patients, relevant physicians provide corresponding health intervention measures to patients [11], and patients manage their own pain according to physicians' intervention measures, so as to improve their health.

Intelligent control is an automatic control that drives functional machines to achieve their goals independently without direct human intervention. The application of artificial intelligence in analgesic system has developed to a new stage. As an important medical instrument, the control mode of analgesia system is related to the patient's safety, comfort and treatment reliability [12, 13]. Therefore, the reasonable choice of control mode is particularly important. (Figure 2)

The operating method of the instrument is based on intuition and experience, and they take appropriate countermeasures to complete the operation and treatment tasks with the experience accumulated in practice. In the intelligent analgesic system, it is just a set of conditions and a qualitative description which are generalized from the knowledge and experience of doctors and experts [14]. However, using fuzzy theory to quantify the controller is a strategy that the controller can accept the doctor's experience and imitate the expert's operation, so a key fuzzy controller based on fuzzy set theory is produced. The research on clinical technology application should be carried out to improve the clinical application technology and broaden the application scope [15,12].
4. Conclusion

Moderate to severe pain can be under control. It has great benefits for physical recovery to reduce pain and provide efficient and economic services for patients with pain. The pain branch of the Chinese medical association has maintained close academic relations with the international society of pain, participated in the activities of world anti-pain day and proposed that “relieving pain is the fundamental right of the people and the sacred duty of doctors”.

The intelligent management meets the actual needs of patients with cancer pain. It can make real-time assessment and record of pain symptoms, regulate and supervise patients' drug treatment, timely carry out cancer pain health education. It assists medical staff to carry out effective intervention at the initial stage of patients’ pain development, and then realizes real-time and whole-process management of cancer pain.

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