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Effect of AI deep learning techniques on possible complications and clinical nursing quality of patients with coronary heart disease

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Abstract

To analyze the effect of AI deep learning techniques on understanding possible complications and improving clinical nursing quality of patients with coronary heart disease. The clinical data of 182 patients with coronary heart disease who received treatment were collected, among which 80 patients received routine nursing management only during hospitalization, set as the control group; AI deep learning techniques were applied to the other 102 patients During treatment and nursing, the incidence of related complications in the control group was higher than that in the observation group, and the average hospitalization time of the patients was longer than that in the observation group. In the observation group, AI deep learning techniques were applied to predict the incidence of complications of coronary heart disease in 14 patients, with an accuracy rate of 87.50% (14/16) and an error rate of 12.50% (2/16). Both the clinical nursing quality and patients' satisfaction score of the observation group were higher than those of the control group, and the overall nursing satisfaction rate of the patients was higher. Applied in prediction of possible complications of hospitalized patients with coronary heart disease, AI deep learning techniques were of high accuracy rate.

Keywords: AI technology; deep learning; coronary heart disease; predication of complications; nursing quality; satisfaction degree.

Practical Application: Predicting the possible complications of hospitalized patients with coronary heart disease using AI deep learning techniques.

1 Introduction

Artificial Intelligence (AI) is a new science and technology that researches and develops theories, methods, technologies and application systems for simulating, extending and expanding human intelligence, and is an important branch of computer science (Iranirad et al., 2017; Evans, 2019). It is an attempt to understand the nature of intelligence and thus to produce an intelligent machine that can respond in a similar way to human intelligence. This field covers a very wide range, including robots, image recognition, language recognition, natural language processing, food security and expert systems etc (Li et al., 2018; Jackson & Cameron, 2020; Hollands et al., 2018). There are various traditional machine learning algorithms for AI implementation, but the most effective and powerful algorithm is the deep learning algorithm, so AI technology at this stage usually refers to deep learning (Zeng et al., 2019). With the rapid social and economic development, and the continuous improvement of living standards, people have paid more and more attention to their health issues and hoped to get high-quality and convenient health care services. The application of AI deep learning technology in medical industry has also obtained tentatively favorable effect, especially in data processing of medical history and predication of illness conditions (Lustberg et al., 2018). As one of the most common cardiovascular diseases in China, the patients with coronary heart disease have severe conditions and rapid changes, heavy clinical treatment and nursing, presenting various risks of potential cardiovascular disease (Weber et al., 2019). Therefore, the patients with coronary heart disease were taken as research objects in this paper to analyze and explore the application value of AI deep learning techniques in prediction of possible complications of this disease, and its effect on improvement of nursing quality.

2 Materials and methods

2.1 General data

The study was approved and supported by the Ethics Committee and relevant units, and the retrospective analysis was conducted. The clinical data of 182 patients with coronary heart disease who were hospitalized in our hospital from

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October 2017 to September 2019 were collected, and the patients were enrolled in different groups based on the nursing management methods, among which 80 patients receiving routine nursing management only were enrolled in the control group; The other 102 patients applying AI deep learning techniques for prediction of complications and receiving personalized nursing management were enrolled in the observation group. Among the enrolled patients, 109 men (59.89%) and 73 women (40.11%), ranging in age from 48 to 80 years old, average age: (65.27 ± 7.34) years old, course of coronary heart disease: 1-13 years, average course of (6.85 ± 1.26) years, 78 patients: high-school education level and below (42.86%), and 104 patients: high-school education level and above (57.14%). The general data of the two groups are shown in Table 1 and there is no significant difference between both groups (P>0.05), indicating the availability of control study.

Inclusion criteria: coronary heart disease diagnosed according to the diagnostic criteria established by International Society of Heart Disease and the World Health Organization (WHO), and confirmed through imageological examination (Grand'Maison et al., 2017); Normal mental state and no history of mental disease; Normal cognitive function, barrier-free language communication, showing cooperation to complete the scale survey; Complete clinical data, informed consent to this study and its purpose.

Exclusion criteria: history of mental disease, mental abnormality and cognitive dysfunction, disability to cooperate with the researchers; Complicated with serious diseases of other organs or malignant tumors; Acute infection, immune system disease, cerebrovascular accident; Patients with valvular disease needing surgical treatment; No informed consent was signed.

2.2 Research method

The patients in the control group received routine nursing management only during hospitalization, including nurses' assistance for patients to complete basic examinations, implementation of infusion nursing, ward management, random health guidance and etc.; The patients in the observation group applied AI deep learning techniques to predict the possible complications and carried out personalized nursing management based on the assessment results. The concrete measures are as following.

AI deep learning techniques

After admission to hospital, the detailed data of patients were collected to establish health records, including previous medical history, clinical diagnosis, examination results, abnormal indicators, living habits and other information. The CHD (coronary heart disease) complication prediction module was used to input the original index data and form the characteristic data through feature extraction process, namely: input indicators - indicating null or 0 - "Yes", suggesting error directly, "No" indicating enter the abnormal prompt of calculation index - query historical prediction record - extract historical prediction result - generate characteristic data; Use the characteristic data to execute the prediction program, call the prediction algorithm function and get the return result of the function. If the result was null, the prediction would fail, and the characteristic data would be processed again. If the result was not null, it would be stored in the database to demonstrate the final result; According to the prediction results of AI deep learning, the related complications that may occur during treatment of patients would be obtained and the nursing intervention could be carried out accordingly.

Personalized nursing management

Set up a personalized nursing management team, including the attending physician, primary nurse, head nurse and etc. to conduct a comprehensive evaluation on the patients' medical records, basic conditions, lifestyle, disease cognition, psychological status and medical needs and etc. Clarify nursing problems and make nursing plans, and inform patients and their families in details of the treatment and nursing-related contents, to obtain their cooperation; On the basis of strengthening the monitoring of vital signs, the intervention measures were taken to explain the pathogenesis, treatment plan and harm of coronary heart disease in straightaway language for patients with low education level and lack of disease knowledge. For the patients with drinking alcohol, smoking and other bad conducts of life, inform them of the adverse impact on the progress of disease, instruct and supervise patients to quit smoking and drinking alcohol, guide them to develop good living habits, regular work and rest. For patients with loss of confidence in treatment, poor compliance and obvious anxiety or depression, one-to-one psychological counseling was conducted to inform them that bad mood and psychology could lead to the decline of the body's immunity, failing to achieve the expected effect; Instruct patients to maintain a diversified diet, eat more lean meat, eggs, soybean products and

Table 1. Comparative analysis of general data of the observation group and control group.

Group	Cases	Gender composition (Men/Women)	Mean age (Year)	Mean course of disease (Year)	Education level [n (%)]	
					Below high-school level	High-school level and above
Control group	80	48/32	64.92 ± 7.85	6.89 ± 1.24	34 (42.50)	46 (57.50)
Observation group	102	61/41	65.33 ± 7.26	6.81 ± 1.30	44 (43.14)	58 (56.86)
x^2/t		0.001	0.365	0.421	0.008	
P		0.977	0.716	0.675	0.927	

x^2/t means the Chi-square test (X^2) or independent sample t test ("t"). The p value is the probability of the hypothesis happening.

other food, ensure adequate daily vitamin intake, eat more fresh fruits and vegetables to prevent constipation, conduct abdominal clockwise massage to promote defecation and reduce the attack of angina pectoris; Combined with the results of complications predicated by AI, arrhythmia, pulmonary edema, myocardial infarction, heart failure and other high-risk patients were warned, pay close attention to the changes of their vital signs and related indexes, timely understand the discomfort symptoms, and guide patients for self-inspection of symptoms. Inform medical personnel to take measures in a timely manner upon any discomfort, to reduce the risks of nursing events; Patients with stable condition were given comprehensive discharge guidance, and WeChat contact was established, so that nurses could keep track of patients' conditions at any time and give targeted guidance.

2.3 Observation index

(1) The general data of the two groups of patients were collected for comparative analysis, including gender composition, average age, average course of disease, education level and etc.;

(2) The length of stay in hospital and the incidence of complications during treatment were observed and recorded, and the incidence of related complications was calculated;

(3) Collect the accuracy and error rate of AI deep learning techniques in predicting the complications of coronary heart disease in the observation group;

(4) The nursing team members used the nursing quality questionnaire of the inpatient department to evaluate the clinical nursing quality of the two groups regularly, including basic nursing, detail nursing, complication nursing, health education, discharge guidance and etc. Each item was 20 points, with a full score of 100 points. The higher the score, the better the nursing quality of the group;

(5) The self-made questionnaires were used to investigate patients' satisfaction with the nursing effect, involving service attitude, nursing level, daily management and risk nursing. 25 points for each item and 100 points for the full score; Total score less than 60 points indicating not satisfied, 60-80 points indicating basic satisfaction and the score more than 80 points indicating very satisfied. The total satisfaction rate is the sum of very satisfied and basic satisfaction rate.

2.4 Statistical analysis

The statistical software SPSS 21.0 was used to process the patients' data and data results. Chi-square test (X^2) and independent sample t test ("t") were used to compare the counting data (%) and measurement data (' x±s) groups respectively. If $P<0.05$, the difference between the groups was considered statistically significant.

3 Results

3.1 Comparative analysis of general data of the observation group and control group

There were no statistically significant differences between the observation group and control group in terms of gender composition, mean age, mean course of disease, education level and other general data ($P>0.05$), indicating comparability. Data details are shown in Table 1.

3.2 Average hospitalization time and occurrence rate of complications of the two groups

During treatment and nursing, the incidence of related complications in the control group was higher than that in the observation group, and the average hospitalization time was longer than that in the observation group. The difference between the two groups was statistically significant ($P<0.05$). Data details are shown in Table 2.

3.3 AI deep learning techniques to predict complications

AI deep learning techniques were applied to predict the incidence of complications of coronary heart disease in 14 patients, with an accuracy rate of 87.50% (14/16) and an error rate of 12.50% (2/16). Data details are shown in Figure 1.

Table 2. Average hospitalization time and occurrence rate of complications of the two groups.

Group	Cases	Hospitalization Tme (d)	Complications [n (%)]					
			Arrhythmia	Pulmonary edema	Myocardial infarction	Heart failure	Cardiogenic shock	Total occurrence rate
Control group	80	18.69 ± 4.25	9 (11.25)	8 (10.00)	5 (6.25)	4 (5.00)	2 (2.50)	28 (35.00)
Observation group	102	12.37 ± 2.46	5 (4.90)	4 (3.92)	3 (2.94)	3 (2.94)	1 (0.98)	16 (15.69)
t/x^2		12.576	2.716	2.854	1.250	0.557	0.676	9.853
P		0.001	0.099	0.091	0.264	0.456	0.411	0.002

x^2/t means the Chi-square test (X^2) or independent sample t test ("t").

3.4 Score and comparison of clinical nursing quality of the two groups

All the scores of clinical nursing quality in the observation group were higher than those in the control group, and the difference between the two groups was statistically significant (P<0.05). Data details are shown in Table 3.

3.5 Comparison of nursing satisfaction between the two groups

The nursing satisfaction score and overall satisfaction rate of patients in the observation group were higher than those in the control group, and the difference between the two groups was statistically significant (x^2=16.371, P=0.001). Data details are shown in Table 4 and Figure 2.

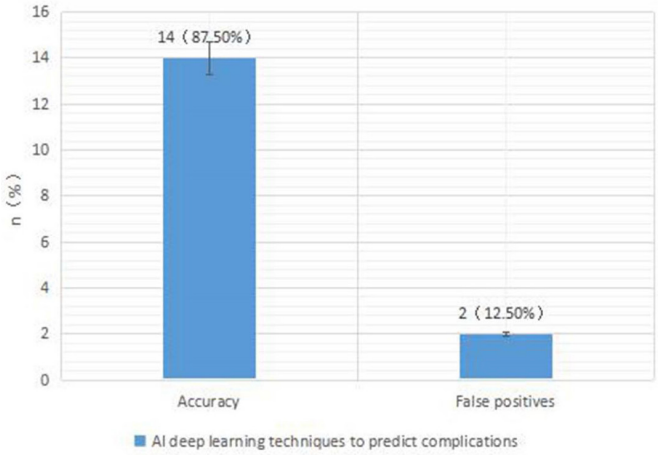

Figure 1. AI deep learning techniques to predict complications.

4 Discussion

In recent years, AI deep learning techniques have been gradually integrated with medical big data, and relevant researches have made massive scientific achievements in medical field (Luo et al., 2019). On the one hand, the application of AI deep learning techniques in medical field helps people know clinical potential risks earlier and more accurately; On the other hand, medical big data also provides a good platform and foundation for application of AI deep learning techniques (Zhu et al., 2018). Existing researches show that the application of AI deep learning techniques analysis on medical data not only shares medical records, disease predication, curative effect prediction and individualized treatment and other services, but also improves the disease prevention or its complications, which has important guiding significance for treatment and nursing, to a certain extent, having promoted the rapid development of modern medical technology (Adriaenssens et al., 2017; Van den et al., 2017). In the previous studies, the scholar Byrne et al. (2017) applied AI technology in endoscopy to explore its effect in colorectal polyp biopsy, and found that the application of AI deep learning could improve the accuracy and diagnostic efficiency of endoscopic optical biopsy of colorectal polyps. It has been shown in the studies of Katsumi Hagita et al. (2018) that AI deep learning techniques have high application value in improving 3D imaging resolution, which is conducive to improving the accuracy of 3D inspection diagnosis. It can be seen that the combination of AI deep learning and medical big data has a broad application prospect.

Coronary heart disease is a kind of heart disease caused by atherosclerotic changes in coronary arteries, narrowing or obstruction of vascular lumen, and hypoxia and ischemic necrosis of myocardial cells (Nishiguchi et al., 2017). It covers a wide range. Embolization and inflammation and etc. may

Table 3. Score and comparison of clinical nursing quality of the two groups.

Group	Cases	Basic nursing	Detail nursing	Complication nursing	Health education	Discharge guidance	Total scores
Control group	102	16.22 ± 4.13	15.04 ± 4.28	16.02 ± 4.15	15.27 ± 3.98	16.14 ± 4.25	79.85 ± 5.64
Observation group		19.24 ± 3.05	18.92 ± 3.11	19.28 ± 2.67	19.15 ± 2.54	18.98 ± 2.03	94.08 ± 3.72
t		5.673	7.080	6.241	7.990	5.943	20.442
P		0.001	0.001	0.001	0.001	0.001	0.001

The "t" means the test statistics of independent sample t test.

Table 4. Comparison of nursing satisfaction between the two groups (ÿ x ± s, points).

Group	Cases	Service attitude	Nursing level	Daily management	Risk nursing	Total scores
Control group	80	18.22 ± 4.88	19.16 ± 5.03	19.24 ± 4.72	18.13 ± 4.92	76.42 ± 6.17
Observation group	102	23.24 ± 3.82	23.76 ± 3.54	22.89 ± 3.12	23.57 ± 3.08	93.34 ± 5.21
t		7.786	7.233	6.261	9.122	20.047
P		0.001	0.001	0.001	0.001	0.001

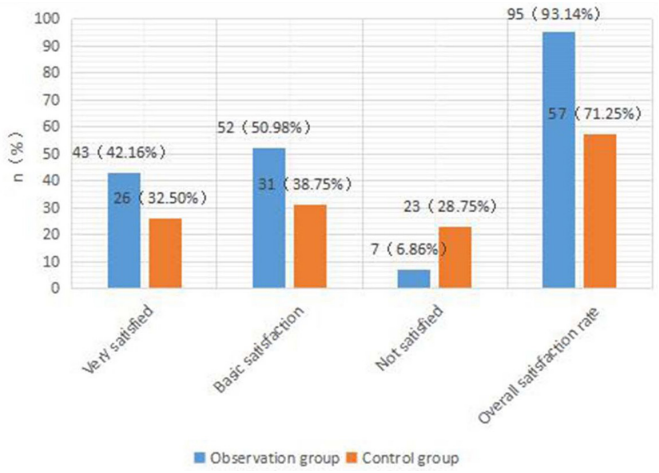

Figure 2. Comparison of nursing satisfaction between the two groups.

cause coronary artery lumen stenosis or obstruction, and with the progress of disease, it is easy to induce arrhythmia, pulmonary edema, myocardial infarction, chronic heart failure, cardiogenic shock and other dangerous complications, directly threatening the life safety of patients (Mohandes et al., 2017). The inpatients with coronary heart disease have a serious and variable conditions, which usually involves medical facilities from multiple departments. Therefore, it is critical to take comprehensive and effective nursing intervention during treatment, and higher requirements are proposed for the professional ability of nursing staff (Salisbury et al., 2017). In this study, the hospitalized patients in observation group applied AI deep learning techniques to predict possible complications, and implemented personalized nursing management based on the assessment results which showed that the quality of clinical nursing was significantly improved, patient satisfaction increased, and the length of hospital stay was effectively shortened, with a reduced incidence of complications. It suggested that the application of AI deep learning techniques could effectively prevent the complications of coronary heart disease, improve the quality of clinical nursing and increase patient satisfaction. It is pointed out in some literatures that the high-risk patients with coronary heart disease show old age, long duration, medical history, disease characteristics such as lack of cognition and unhealthy life-style, therefore, the comprehensive collection of patients' data for feature screening will predict the risk of related complications in a more accurate way, providing a clear direction for the formulation of nursing plan and implementation of nursing (Kinnaird et al., 2018). In the observation group, AI deep learning techniques were applied to predict the possible complications of coronary heart disease in 14 patients, with an accuracy rate of 87.50%. In addition to strengthening the basic nursing, the observation group also took a series of health education, psychological counseling, daily management, discharge guidance and nursing measures for prevention of complications. The nursing staff were on the alert for high-risk patients of complications which were predicated through AI deep learning techniques, paid close attention to the changes of patients' vital signs and related indexes, guided patients for self-inspection of symptoms, and informed medical personnel to take measures in a timely manner upon any discomfort of patients, to avoid the risks of nursing events.

In conclusion, AI deep learning techniques have a higher accuracy rate in prediction of possible complications of inpatients with coronary heart disease, and its outcome can be used as the guidance basis for implementing personalized nursing management, which is conducive to improving the quality of clinical nursing and overall satisfaction rate of patients, thus maintaining the value of promotion and application.

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