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The Temporal Profile of OPG Expression and Regulatory Role on Ischemic Brain Injury in Rats After MCAo

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ABSTRACT

Objective To investigate the temporal profile of osteoprotegerin (OPG) in middle cerebral artery occlusion (MCAo) rats and the serum level of RANKL and ALP in OPG deficient and wild type rats.

Methods Rats was anesthetized and subjected to MCAo by transient occlusion of middle cerebral artery occlusion. The serum level of OPG, RANKL and ALP in rats after MCAo was examined by ELISA assay. The protein expression of OPG in ischemic brain was determined by Western blot analysis.

Results The level of OPG in the rat serum was significantly increased from 6 h after MCAo and peaked at 12-24 and 72-168 h. The protein expression of OPG was upregulated from 12 h after MCAo and peaked at 72 h. The level of RANKL and ALP was significantly decreased in OPG deficient rats after MCAo.

Conclusion OPG/RANKL signaling is associated with brain injury after MCAo, indicating a potential therapeutic target for ischemic stroke.

Keywords cerebral ischemia; osteoprotegerin; receptor activator of nuclear factor-κB ligand

INTRODUCTION

Stroke is one of the main cause of death and disability worldwide following cancer and cardiovascular diseases, rising with the increase of age[1]. The burden of ischemic stroke increased significantly and led to brain injury, edema, hemorrhage and neuronal death[2]. However, the pathogenesis is not fully understand. Hundreds of targeting chemicals were developed, but there are few effective drugs against stroke.

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Osteoprotegerin (OPG) is a soluble protein which bands to a receptor activator of nuclear factor-κB ligand (RANKL) [3]. It is reported that elevated level of OPG in the serum was closely related to the severity and poor functional outcome of ischemic stroke[4-6]. OPG/RANKL signaling has been known to work on vascular calcification and immune system[7, 8]. In the present study, we examined the temporal expression of OPG in ischemic brain and the regulation on RANKL and ALP in a transient middle cerebral artery occlusion model using $OPG^{-/-}$ rats.

MATERIALS AND METHODS

ANIMAL PROCEDURE

All animal procedures were undertaken in accordance with the guidelines for animal care and welfare and were approved by the Ethical Committees of Weifang Medical University. All animals were kept at about 23 ± 2°C and a 12 h light/12h dark cycle with free access to tap water and diet.

TRANSIENT MIDDLE CEREBRAL ARTERY OCCLUSION (MCAo)

Rats were randomly divided into sham operated group and MCAo group. Rats were anesthetized with intraperitoneal injection of chloral hydrate and subjected to MCAo as previously reported. In short, a silicon coated 4-0 monofilament nylon suture with a rounded tip was inserted from the right common carotid artery and gently advanced until it occlude the middle cerebral artery. The monofilament was gently removed after reperfusion. In sham-operated animals, all procedures were performed except occlusion of the middle cerebral artery. The animals received humane care and kept under 37°C.

ELISA

The blood was obtained at the end of the experiment and centrifuged at 3000 rpm for 15 min to collect serum. The level of osteoprotegerin (OPG), receptor activator for nuclear factor-κB ligand (RANKL) and alkaline phosphatase (ALP) in the plasma was determined using commercially available ELISA kit according to the manufacture's instructions.

WESTERN BLOT ANALYSIS

The brain tissues were homogenized in lysis buffer containing containing pepstatin 1, leupeptin 2, phenylmethyl -sulfonyl fluoride 1. The lysates were centrifuged at 12000 rpm for 30 min and the concentration was detected using coomassie brilliant blue staining method. 60 μg of protein in each sample were separated using SPS-PAGE. The protein samples were transfered into polyvinylidene fluoride (PVDF) membranes for immunoblotting. The PVDF membranes were blocked using 7.5% defatted milk. Then the primary antibody against OPG and GAPDH were used to incubate the membranes at 4°C overnight. After incubated with anti-rabbit IRDye700DX®-conjugated second antibody or anti-mouse IRDye800DX®-conjugated antibody (1:5000, Rockland, USA), the bands were detected by an Odyssey infrared imaging system. The intensity of the bands were quantitatively evaluated using Quantity One® analysis software.

STATISTICAL ANALYSIS

All data were presented as mean ± SD. The significance of differences among groups was assessed using one-way ANOVA followed by Bonferroni's post hoc test using the software Prism 5.0 (GraphPad Software).

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$P < 0.05$ was considered statistically significant.

RESULTS

Temporal profile of OPG content and expression.

To investigate the regulatory role of OPG after ischemia, we examined the level of OPG in the rat serum after MCAo. As shown in Fig.1, the level of OPG in the serum was increased at 6 h after MCAo and peaked at 12-24 h and 72-168 h after MCAo. In rats, OPG protein expression in ischemic brain was increased and peaked at 12 h and 72 h after MCAo (Fig.2). These data indicate that OPG primarily acts in the acute stage of ischemic brain.

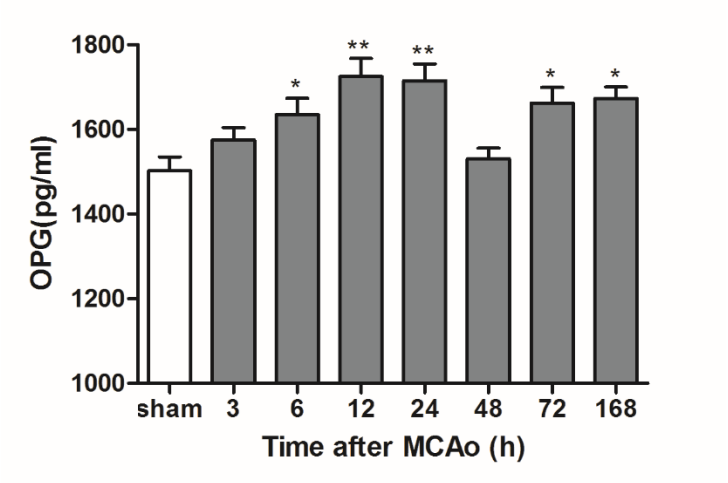

Fig.1 The level of OPG in rat serum after MCAo. The plasma OPG was examined using ELSIA assay at 3, 6,12 24, 48, 72, 168 h after MCAo in rats. n=4 in each group. $^{*}P < 0.05$, $^{**}P < 0.01$ vs sham-operated rats.

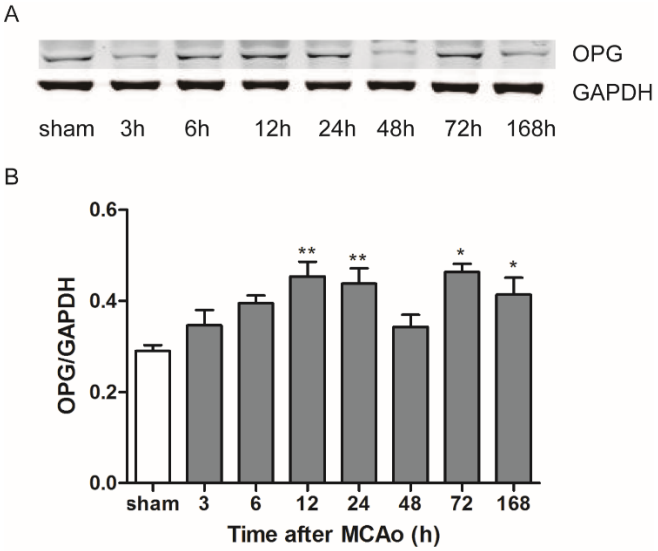

Fig.2 The protein expression of OPG in rats after MCAo. The expression of OPG protein was analyzed by Western blot. n=3 in each time point. $^{*}P < 0.05$, $^{**}P < 0.01$ vs sham-operated rats.

Changement of RANKL and ALP in the plasma of rats after MCAo.

To elucidate the role of OPG/RANKL signaling, we examined the changes of RANKL and ALP in the plasma using ELISA detection assay. 24 h after MCAo, we examined the content of RANKL and ALP in the plasma in OPG-/- and WT rats. As shown in Fig.3A and 3B, the level of RANKL and ALP in the plasma was

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significantly increased 24 h after MCAo compared with OPG-/- sham-operated rats. The level of RANKL and ALP in OPG-/- rats was significantly decreased compared with that in WT rats after MCAo. These results indicated that the OPG/RANKL signaling played important roles in MCAo rats.

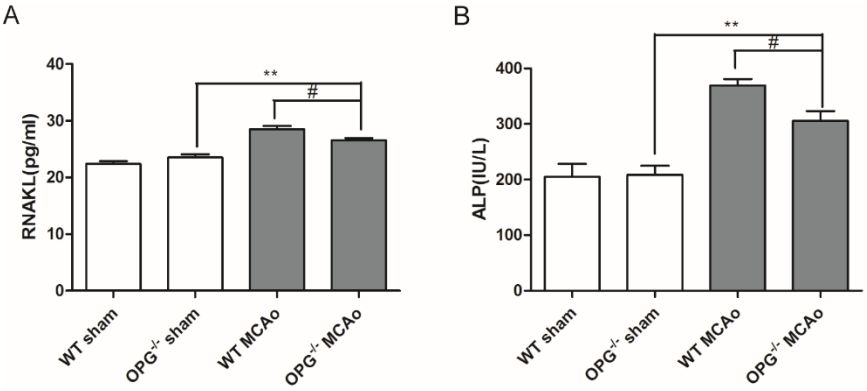

Fig.3 The content of RNAKL and ALP in the serum of rats. Serum RNAKL and ALP was examined using ELISA assay at 24 h after MCAo in $OPG^{-/-}$ rats. n=3 in each time point. $^{**}P < 0.05$ vs $OPG^{-/-}$ sham operated rats, $^{\#\#}P < 0.01$ vs WT rats subjected to MCAo.

DISCUSSION

Stroke is the leading cause of mortality and disability in adults since millions of Chinese people died from ischemic stroke[9-11]. Therefore, it is important to develop more effective treatment of ischemic stroke. In the present study, we investigate the temporal expression of OPG in the plasma and ischemic brain in the middle cerebral artery occlusion for different points of reperfusion.

It has been reported that OPG/RANKL/RANK signaling was involved in brain ischemia[12, 13]. Increased level of OPG in the serum has been observed in patients with ischemic stroke, which is related with the severity of stroke. The regulatory role of OPG in ischemic brain injury is not yet known. Here we demonstrated that the level of OPG protein in the infarct region was increased from 6 to 24 h after middle cerebral artery occlusion. The protein expression of OPG peaked again 72h after MCAo. Moreover, in OPG deficient rat, the level of RANKL and ALP in the plasma was decreased significantly after ischemia. Further studies are necessary to clarify the mechanisms that how OPG deletion regulated the expression of RANKL.

The present study demonstrated that OPG/RANKL signaling could be associated with cerebral and other diseases in central nervous system. Further studies on the OPG/RANKL system in the brain might shed light on molecular mechanisms involved in brain injury and be a potential therapeutic target for ischemic stroke.

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Clinical Data Analysis of Nodular Erythema

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Abstract

Objective Investigate the relationship between clinical manifestations and pathological changes of Erythema Nodosum.

Subjects and Methods 94 patients diagnosed with erythema nodosum were collected by the clinical data.

Results Five etiologies were treated, which was found by $p<0.05$. It shows that the recovery within one month was statistically significant. 9 of 94 patients were diagnosed with TB infection. 7 patients were found with multiple nuclear giant cells infiltration in the HE pathological films.

Conclusion The treatment of erythema nodosum is mainly due to treatment. It shows that there are multinucleated giant cells in the pathology, which may be suspected of tuberculosis infection.

Keywords Erythema Nodosum; Mycobacterium Tuberculosis; Pathology

Introduction

The pathological features of erythema nodosum showed the change of cutaneous panniculitis. At present, the etiology is unknown and considered to the following factors:1.infection: bacteria, viruses, fungi, mycoplasma, chlamydia, etc. Mycobacterium tuberculosis and other mycobacteria are considered by rare infected pathogens; 2.connective tissue diseases related; 3.endocrine system disorders; 4.drugs; 5.tumors; 6.pregnancy[1].

China is a country with high incidence of Mycobacterium tuberculosis, and the relationship between Mycobacterium tuberculosis and nodular erythema deserves attention[2].

We analyse the relationship between erythema nodosum and Mycobacterium tuberculosis from clinical data, and further provides reference for clinical diagnosis and treatment.

Materials and methods

Ninety-four patients with erythema nodosum were diagnosed in the dermatology department of our

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hospital from 2003 to 2018.

Methods of retrospective investigation and analysis were used to record the sex, age of diagnosis, clinical manifestation of tuberculosis, history of tuberculosis (history of tuberculosis, history of contact with tuberculosis), and methods of clinical examination for tuberculosis screening.

China promulgated the Classification of WS 196-2017 Tuberculosis and the Diagnostic criteria of WS288-2017 Tuberculosis on 9 November , 2017.

Statistical analyses

The obtained data were analyzed with the Statistical Package for the Social Sciences (SPSSVR) version 19.0 (IBM Corporation, Armonk, NY, USA). Discrete analysis of age distribution and chi-square test of treatment principles and efficacy. Statistical significance was defined as p values of <0.05.

Results

Table 1 Age distribution of 94 patients

Age of onset	＜18	18-44	44-59	≥60
	7	55	21	11
Female n (%)	5(71.4)	39(70.9)	19(90.5)	9(81.8)
Mean age	13.0	34.4	50.9	72.8

Table 2 Analysis of pathological sites in patients with nodular erythema

Pathological site	Foot	Leg	Thigh	Limbs	Upper Limbs	Popliteal Fossa	Oral Cavity
	2	40	25	20	5	1	1

94 patients were distributed between 18 and 59 years old, indicating that the prone population was among the young and middle-aged patients(table 1 and figure 1). The lesions were mainly distributed in legs. But we further analysis the site of erythema nodosum involving the limbs, but did not mention the specific sites that could be involved.This study can be seen that there are a variety of sites, such as mouth, popliteal

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fossa, oral cavityand so on(table 2).

Table 3 Summary of laboratory findings, treatment options and prognosis of patients with nodular erythema

diagnosis	number	treatment	Healing (30d)
Bacteria except TB suggested	15	Antibiotics	7
TB infection	12	Anti-tuberculosis drugs	8
suggesting connective tissue diseases	12	Hormone/immune inhibitor/hormone immunosuppressant	9
No infections and connective tissue diseases	24	Hormone/immune inhibitor/hormone immunosuppressant	19
No laboratory related data	30	Hormone	30

The results of laboratory examination showed that the etiology of 94 patients was diversed (table 3). The above five diagnostic results were analyzed, and after the corresponding treatment plan was carried out, the SPSS statistics were carried out, and the p was found to be 0.009(<0.05), which indicated that the treatment was statistically significant within one month.

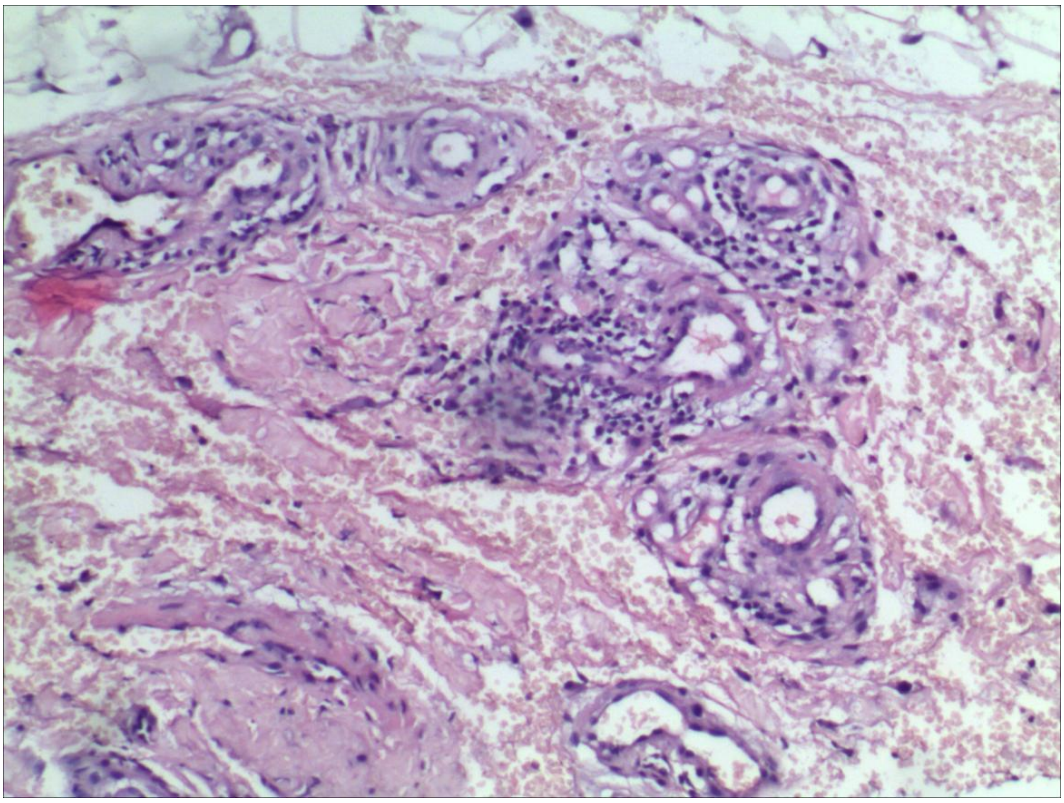

Fig2: Fat lobular necrosis at intervals, intralobular inflammatory cell infiltration, small vessel wall degeneration necrosis, lumen blockage. (HE,10X10).

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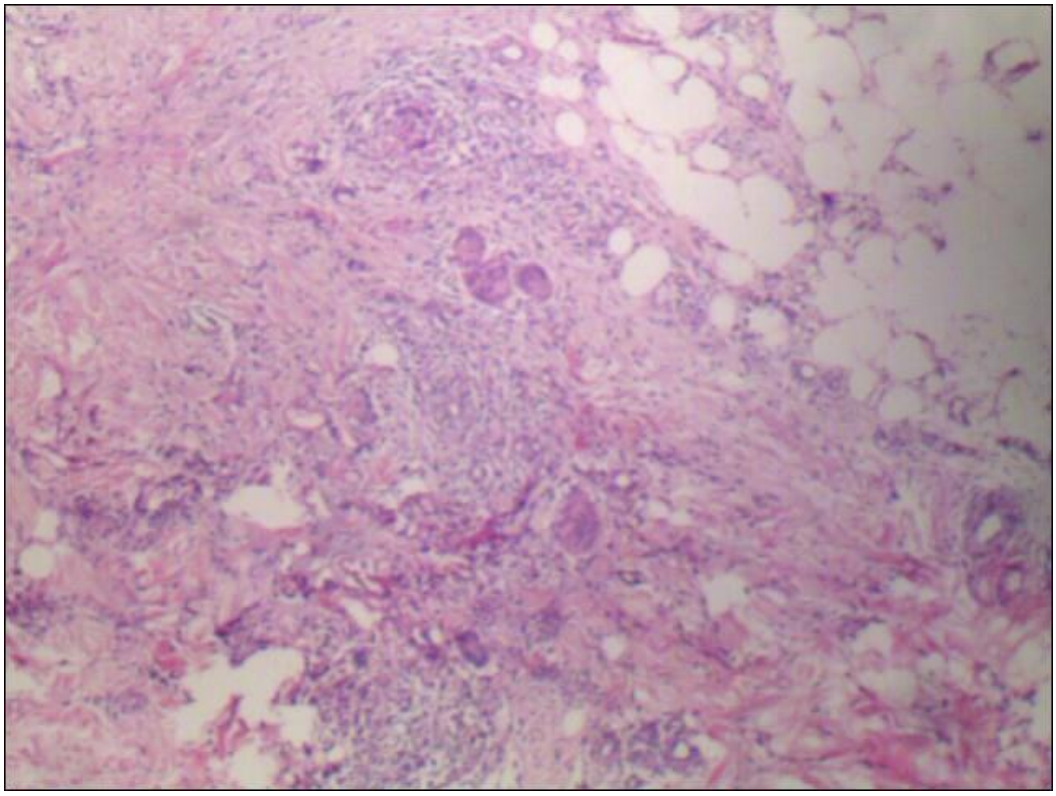

Fig3: partial fat lobular necrosis, and polynuclear giant cells (HE 10X10).

HE histology of all selected patients showed changes in cutaneous panniculitis. Adipose lobular septal fibrous tissue proliferation and a large number of inflammatory cell infiltration were observed in the HE pathology of the patients. Adipose interlobular septa were found with cells such as lymphocytes and histiocytes and neutrophils from 85 patients. The remaining 9 cases indicated TB infection, of which 7 patients had suggesting multiple nuclear giant cell infiltration in the HE pathological films.

Discussion

China has a high incidence of tuberculosis. Among many diseases with unknown etiology, Mycobacterium tuberculosis is associated with the incidence of these diseases. Infection of Mycobacterium tuberculosis has been paid more and more attention in recent years[3]. In particular, some authors believe that Mycobacterium tuberculosis is considered to be a factor of erythema nodosum[4].

At present, it is believed that the pathogenesis of nodular erythema is: 1, foreign antigens cause delayed hypersensitivity; 2, antigens stimulate the body to produce antigen-antibody complexes, antigen-antibody complexes are deposited in the vascular wall, and local inflammatory reactions are caused by complement pathway[5].

We analyzed the clinical data of 94 selected patients, and found that the onset age of the selected patients was between 18 and 59 years old, and the female patients were significantly more than the male, which may be related to estrogen and progesterone secretion[6]. It might also be related to the treatment of the disease in female patients than in male patients. Though we can't trace the specific location of each patient, we could not only judge the pathological sites of the patient at that time. We only knew that the sites of

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nodular erythema were diverse. Perhaps exogenous substances can be in different parts because of leukocyte fragmentation vasculitis[7].

Although the etiology of nodular erythema is unknown, there are several clinical causes: infection-related, connective tissue disease-related, unrelated infection and connective tissue disease[8]. Treatment can improve the cure rate of the disease and guide the clinic. According to the previous literature, the possibility of nodular erythema caused by TB infection is very low. But taking results of 94 patients into account, we can realize that the number of patients with Mycobacterium tuberculosis is not in the minority.

HE histopathological films of 94 patients were analyzed again. There were no caseous necrosis and Langerhans cells [9]and no obvious tuberculosis infection in the pathological changes of 94 patients. However, we find that some patients have local tissue necrosis and occasionally polynuclear giant cells[10] in HE pathological films. The results are similar to those reported in the literature, indicating that the inflammatory reaction between the multinucleated giant cells and lobules can occur on the histopathology of patients with tuberculous erythema. According to the results, we can see that there were polynuclear giant cells infiltration on the HE histopathological films of patients with erythema nodosum in the future, suggesting that the pathogenesis of this patient may be related to the infection of tuberculous bacteria.

Due to the lack of understanding between Mycobacterium tuberculosis and nodular erythema and the lack of relevant laboratory data, some patients can further expand the number of cases in the future. And the discovery of nodular erythema as far as possible night-related screening TB laboratory examination, it is more perfect.

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Disclosure statement

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this article.

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The Self-Directed Learning Ability of Junior Nurses in the Emergency Department: An Up-to-date Survey

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ABSTRACT

Objective This study aimed to evaluate the self-directed learning ability of junior emergency department (ED) nurses and provide the rationale for whether it is necessary to strengthen the training of junior ED nurses.

Methods Using the convenience sampling method, a self-directed learning ability questionnaire survey was conducted among 358 junior ED nurses in several tertiary hospitals in Guangdong Province.

Results The total score of self-learning ability of junior ED nurses was 119.85±16.82 (scores >135, 85-135, and <85 indicate excellent, intermediate, and poor self-learning ability, respectively). The retrospective analysis showed that gender, whether having participated in academic education, and the degree of motivation for promotion were major factors that affected the self-learning ability of junior ED nurses ($P<0.05$).

Conclusions The self-learning ability of junior ED nurses in Guangdong is at an intermediate level. Nursing managers should pay more attention to the junior ED nurses with poor self-learning ability. In particular, adopting various training methods and establishing appropriate promotion mechanisms and economic incentive measures may help improve their self-learning ability and enable them to meet job requirements.

Keywords Emergency department; Junior nurses; Self-directed learning; Influencing factors

INTRODUCTION

The emergency department (ED) is the first line of defense for the hospital to treat critically ill patients, and ED nurses play an important role in the rescues. However, in the emergency department of most

domestic hospitals, junior nurses with little experience account for a large proportion of ED nurses [1]. It has been reported that ED nurses at junior levels may have insufficient operational, critical thinking, proactive problem-solving skills that are required for critically ill patient care, which affects the overall core competence of ED nurses and the success rate of patient rescue [2]. Therefore, it is necessary to train the nurses at junior levels in the emergency department. However, the traditional training model for the junior ED nurses is mostly passive, which makes it difficult to achieve good training results [3]. The self-directed learning ability of nurses refers to the ability of nurses to take advantage of their subjective initiative to have a strong desire to learn knowledge actively, and particularly, to master the knowledge and skills necessary for nursing work with high quality [4]. The study aimed to evaluate the self-directed learning ability of junior ED nurses and provide a basis for guiding nursing managers to develop training plans suitable for junior ED nurses.

MATERIALS AND METHODS

Research participants

In March 2021, using a convenience sampling method, 358 junior ED nurses from a number of tertiary hospitals in Guangdong Province were enrolled in this study. The inclusion criteria were 1) having a nurse practitioner qualification certificate from the People's Republic of China, 2) working in the ED for over 6 months, and 3) the respondents agree to participate in this survey. The exclusion criteria included 1) those who could not complete the questionnaire in time due to study abroad, maternity leave, personal leave, etc., 2) those who did not actively cooperate and did not answer the questionnaire carefully, and 3) those who had been on the job for less than 6 months.

General information collection form

This form was a self-designed general information survey form for nurses. The collected information included gender, working years, education, job title, whether they are staff members, whether they have participated in academic education, monthly income, whether they are specialized nurses, their desire for promotion, and their marital status.

Assessment tool for self-directed learning ability of junior ED nurses

The self-directed learning ability evaluation scale developed by Shuqin Xiao from China Medical University (CMU) in 2008 was used for the evaluation [4]. This scale included four dimensions, namely self-motivation beliefs, task analysis, self-monitoring and adjustment, and self-regulation, with a total of 34 items. Using the Likert 5-level scoring system, "Strongly disagree", “Disagree”, “Neither agree nor disagree”, “Agree”, “Strongly agree" are scored 1-5 points respectively; negative items are scored in reverse. The higher the score, the stronger the self-learning ability. A score ≥ of 136 indicated excellent self-directed learning ability, a score between 85-135 is indicated moderate self-directed learning ability, and a score ≤ of 84 indicated poor self-learning ability. The Cronbach's Alpha Reliability Coefficient of this scale is 0.944.

Data collection method

Before starting this investigation, the consent and cooperation of the nursing staff in the ED of each hospital were obtained. The number of questionnaires to be issued and the survey time were determined according to the specific conditions of the ED of different hospitals. The researcher stated the purpose of the survey before the questionnaire started. After obtaining the informed consent of the research subjects, the respondents began to fill out the questionnaire (through an online platform). A total of 358 questionnaires were returned, all of which were valid questionnaires, with an effective rate of 100%.

Statistical analysis

The statistical analysis was carried out using SPSS 24.0 software. The data of general information of junior ED nurses were described by frequency and percentage. Measurement data were expressed as mean and standard deviation (mean±SD). Logistic regression analysis was used to analyze related factors. A p-value of less than 0.05 indicated that the difference was statistically significant.

RESULT

The general information of the junior ED nurses

As shown in Table 1, among the junior ED nurses who participated in the questionnaire (n=358), 184 (51.4%) had a junior college degree. Most junior ED nurses (60.3%) had job titles as nurses. There were 178 people (49.7%) with 3-5 years of work experience, and 180 people (51.3%) with less than 3 years of work experience. Most of them were contractors with strong motivation for promotion.

Table 1. The general information of the junior ED nurses

Items		N (%)
Gender	Male	68 (19.0)
	Female	290 (81.0)
Working experience	<1 year	44 (12.3)
	1-2 years	76 (21.2)
	2-3 years	60 (16.8)
	3-5 years	178 (49.7)
Job title	Assistant nurse	24 (6.7)
	Nurse	216 (60.3)
	Senior nurse	100 (27.9)
	Supervisor nurse	18 (5.1)
Degree	Technical secondary school	27 (7.5)
	Junior College	184 (51.4)
	Bachelor	146 (40.8)
	Master or higher	1 (0.28)
Motivation for promotion	Very strong	120 (33.5)
	Strong	130 (36.3)

	Not very strong	104 (29.1)
	None	4 (1.1)
Full-time employee	Yes	24 (6.7)
	No	334 (93.3)
Participated in academic education	Yes	228 (63.7)
	Never	64 (17.9)
	No, but plan to	55 (15.4)
	No, and not plan to	11 (3.1)
Marital status	Married	100 (27.9)
	Unmarried	256 (71.5)
	Others	2 (0.6)

The score of self-directed learning ability evaluation scale

The average score of the self-directed learning ability evaluation scale for 358 junior ED nurses was 118.99±19.55. The scores of each dimension were shown in Table 2.

Table 2. The self-directed learning ability evaluation scale score of junior ED nurses

Item	Item numbers	Score (Mean±SD)
Self-motivation beliefs	14	50.3±8.39
Task analysis	6	20.08±4.06
Self-monitoring and adjustment	10	34.67±6.19
Self-regulation	4	13.94±2.47
In total	34	118.99±19.55

The self-directed learning ability among junior ED nurses with different characteristics

The comparison of self-directed learning ability among junior ED nurses with different characteristics is shown in Table 3 and the assignment of independent variables is detailed in Table 4.

Table 3. The comparison of self-directed learning ability among junior ED nurses with different characteristics

Items		Scores	t/F value	P value
Gender	Male	123.24±19.17	4.122	0.042
	Female	117.99±19.54		
Working experience	<1 year	122.89±18.33	2.564	0.464
	1-2 years	119.34±21.2		
	2-3 years	119.78±20.35		
	3-5 years	117.6±18.84		
Degree	Technical secondary school	116.41±18.2	3.715	0.294
	Junior College	118.51±17.87		
	Bachelor	120.23±21.71		

	Master or higher	94±NA*		
Job title	Assistant nurse	123.75±15.21	2.865	0.413
	Nurse	118.95±19.42		
	Senior nurse	118.47±21.52		
	Supervisor nurse	115.89±14.26		
Full-time employee	Yes	116.38±17.56	0.683	0.409
	No	119.17±19.7		
Participated in academic education	Yes	120.52±18.81	15.266	0.002
	Never	114.7±18.46		
	No, but Plan to	120.67±21.49		
	No, and not plan to	103.73±23.05		
Income (¥)	<5000	118.98±18.84	3.126	0.373
	5000-10000	119.96±20.12		
	10000-15000	116.07±18.59		
	15000-20000	110.6±16.83		
Specialist nurse	Yes	117.35±22.22	0.12	0.729
	No	119.14±19.31		
Motivation for promotion	Very strong	124.47±21.59	35.741	<0.001
	Strong	120.89±17.07		
	Not very strong	110.39±17.24		
	None	115.75±18.21		
Marital status	Married	118.96±19.56	1.848	0.397
	Unmarried	119.35±19.67		
	Others	103.5±9.19		

*Note：Only one person was in this category, so the SD value was not available.

Table 4. Assignment of independent variables

Variables	Assignment method
Gender	Male=1；Female=2
Participated in academic education	Yes=1；No=2；No but plan to=3；No and not plan to=4
Motivation for promotion	Very strong =1; Strong=2; Not very strong =3；None=4

DISCUSSION

Junior ED nurses need to improve their self-directed learning ability

In this study, the self-directed learning ability score of junior ED nurses is 118.99±19.55, indicating that self-directed learning ability of junior ED nurses in Guangdong Province is at an intermediate level. This score is lower than the scores in the research reported by Pingping Zhuang et al. [5], Xiaolan Diao et al. [6], and Chen Qian et al. [7] suggested that self-directed learning ability of junior ED nurses needs to be improved.

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Regarding the scores of four dimensions, the score of self-motivation belief was the highest, while the score of self-evaluation was the lowest; these results were consistent with the research results by Jiannv Wang et al [8]. Junior ED nurses may relate the reason for this score to the lack of monitoring of learning. Although they have a strong belief in learning, they lack the relevant experience in effectively learning professional knowledge since they have just entered this field. Similarly, the study by Jiannv Wang et al. has pointed out that junior nurses at the initial stage of career development are usually inexpensive and may often lack critical thinking skills to adjust learning strategies timely [8]. Therefore, emergency care managers may need to help improve their independent learning ability (for instance, setting learning goals) and supervise the learning efficiency of junior ED nurses.

Analysis of the influencing factors of the self-learning ability of the junior nurses in the emergency department

As shown in Table 3, gender, whether they have participated in academic education, and the degree of willingness to promote professional titles are the major factors affecting the self-directed learning ability of junior ED nurses ($p<0.05$).

Male junior ED nurses seem to have stronger self-directed learning abilities in comparison to female junior ED nurses

As shown in Table 3, the self-directed learning ability of male junior ED nurses is higher than that of female junior ED nurses. The reasons for this discrepancy are as follows. First, emergency work is intense and fast-paced. Male nurses might be physically and psychologically more competent than female nurses in emergency department work. Also, many hospitals tend to hire male nurses in the emergency department when recruiting nurses. However, in the traditional Chinese viewpoint, the nursing profession is full of prejudice and discrimination against men [9]. To get rid of this kind of prejudice and discrimination, male nurses tend to have a strong enterprising spirit to be successful in their careers. This mindset may drive them to learn actively, have better independent learning ability, and have a relatively clear career development plan. On the other hand, nurses with a clear career plan tend to have a high self-directed learning ability since clear goals can guide them to keep learning [10].

Junior ED nurses who have participated in academic education have a stronger self-learning ability than those who have not

This study also shows that junior ED nurses who have participated in academic education are more capable of autonomous learning, which is consistent with the results of Cunmei Tan et al [11]. Among the research participants, 211 people (58.9%) had a college degree or a technical secondary school degree. As undergraduate education is becoming more and more popular today, undergraduate degree is the basic educational requirement for nurses' promotion and further training. Therefore, a large number of nurses promote themselves through continuing education. They have shown their ability to pass the exam successfully, and getting a diploma has been a learning goal for them. To reach the goal, they need to formulate a specific study plan, and the school's requirements for the curriculum have played a monitoring

and regulating role. These learning experiences of junior ED nurses post-employment may improve their independent learning ability, making them superior to the junior ED nurses in terms of self-directed learning ability.

Junior ED nurses with a strong desire for promotion have strong self-learning ability

This study shows that junior ED nurses who have a strong desire for promotion have better learning ability. This is consistent with the previous results showing that nurses with good self-learning ability are more likely to pass the qualification examination and be promoted smoothly [7]. In most hospitals, the higher the professional title, the better the corresponding treatments, and the more opportunities for studying and training; these opportunities are the reasons why many people want to be promoted. On the other hand, the promotion of the professional title itself can be a goal. The promotion requires junior ED nurses to self-monitor and adjust and requires them to actively learn relevant knowledge and meet the promotion requirements in theory and scientific research. Therefore, to a certain extent, the desire for promotion helps improve their independent learning ability.

Strategies to improve the self-directed learning ability of junior ED nurses

The results of this study show that the self-directed learning ability of junior ED nurses is greatly affected by the three factors, including gender, whether they have participated in academic education, and the desire to be promoted. Therefore, starting from these three aspects and formulating relevant practical strategies are critical to improving their independent learning ability. First, nursing managers can work on the shift schedule of nurses, arranging the nurses with different genders, professional titles, and educational backgrounds in a better way that they can have positive influence on each other in their daily work. Secondly, different training programs can be introduced to junior ED nurses with different requirements and different levels. Particularly, the training programs, either through modeling rewards and incentive mechanisms [12] or psychological interventions [13] that can help them formulate clear career development plans and continuing education plans are beneficial. Third, setting small goals and appropriate financial rewards, as well as proper supervising, are critical; junior ED nurses could gradually develop the self-directed learning ability in the process of achieving their goals.

CONCLUSION

The self-learning ability of junior ED nurses in Guangdong Province is at an intermediate level. Nursing managers should pay more attention to the ED nurses with poor self-learning ability. In particular, adopting various training methods and establishing appropriate promotion mechanisms and economic incentive measures may help improve their self-learning ability and enable them to meet job requirements.

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STATEMENT

There is no conflict of interest in this article.

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