



## Analysis of the effect of anti-tuberculosis therapy combined with all-in-one nursing care on the alleviation of inflammation in patients with pulmonary tuberculosis

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### ABSTRACT

To analyze the application effect of anti-tuberculosis therapy (ATT) combined with all-in-one nursing care on pulmonary tuberculosis (PT). Seventy-four PT patients who received ATT in our hospital between December 2015 and June 2016 were selected as the research participants and randomized into a research group (RG; n=37) and a control group (CG; n=37) that were given all-in-one nursing care and routine care, respectively. The cure rate and treatment compliance were compared between groups, and the awareness of disease prevention and treatment was investigated. Patients' psychological status and quality of life were evaluated using the Self-Rating Depression/Anxiety Scale (SAS/SDS) and the Quality of Life Questionnaire Core 30 (QLQ-C30), respectively. RG and CG were not statistically different in the clinical cure rate ( $P>0.05$ ), but the X-ray cure rate was higher and the recurrence rate was lower in RG ( $P<0.05$ ). In addition, RG showed higher medication compliance rate, regular reexamination rate and awareness of disease prevention and treatment than CG ( $P<0.05$ ). Reductions in SAS/SDS scores were observed in both groups after care, with even lower levels in RG, while the QLQ-C30 score increased and was higher in RG as compared to CG ( $P<0.05$ ). Therefore, All-in-one nursing care can effectively enhance the level of treatment compliance and awareness of disease prevention and treatment of PT patients. In the future, when treating PT patients in the clinic, the effectiveness of ATT can be improved by implementing all-in-one nursing care to provide more reliable prognosis for patients.

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### Introduction

Pulmonary tuberculosis (PT) is a respiratory infectious disease caused by *Mycobacterium tuberculosis* infection, five types of primary PT, hematogenous PT, infiltrative PT, tuberculous pleurisy, and extrapulmonary TB are included (1). The occurrence of PT can cause patients to develop systemic symptoms such as fever and malaise and respiratory diseases such as cough and sputum, PT is also defined as a chronic inflammatory condition caused by a purulent bacterial or fungal infection, and its pathological progression is closely related to the intensification of the inflammatory response (2). The World Health Organization (WHO) statistics indicating 1.7 billion latent PT infections worldwide in 2017 and approximately 10 million new cases every year (3). PT is also one of the top ten causes of death in the world, with a case fatality rate of about 17 per 100,000 (4). Despite reductions in morbidity and mortality, PT remains one of the most common infectious diseases in clinical practice. The current clinical

treatment for PT is still based on long-term (generally 6-9 months) anti-tuberculosis therapy (ATT), that is, symptomatic treatment against the causative agent, commonly used drugs include streptomycin, isoniazid, rifampicin, pyrazinamide, etc., and the inability to provide long-term professional medical services and follow-up observation is an important problem to be solved urgently in the treatment of PT (5). For this reason, PT patients often suffer from illness aggravation and even infection of other family members during ATT due to a lack of medical and health expertise (6).

In recent years, personalized care strategies proposed in clinical practice may be the key to improving the shortage of professional medical services and guidance in long-term treatment (7). Among them, all-in-one nursing care is a novel nursing strategy put forward by the American Nurses Association. Its purpose is to establish doctor-nurse cooperation, so that both parties can recognize and accept their respective behaviors and scope of responsibilities, protect the interests of both parties and achieve common

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goals, and change the traditional model of medical care that is simply working together (8). The use of all-in-one nursing care can not only enable patients to obtain more professional and targeted medical services and guidance, but also improve the enthusiasm and sense of achievement of medical staff, which is of great significance for improving the overall medical quality (9). At present, all-in-one nursing care has been clinically confirmed to be effective in the treatment of malignant tumors and other diseases, and is extremely suitable for diseases with long treatment cycles like diabetes (10, 11). However, few studies have reported its therapeutic application in PT.

Accordingly, this study discusses the application effect of ATT combined with all-in-one nursing care in PT, aiming at providing new reference opinions for future PT treatment and providing patients with a more reliable prognosis guarantee.

## Materials and Methods

### Patient information

This study selected 74 PT patients who received treatment in our hospital between December 2015 and June 2016 and randomly grouped them into a research group (RG; n=37) and a control group (CG; n=37) that were given all-in-one nursing care and routine care, respectively, in addition to ATT. This research has been ethically ratified by our hospital, and all the above research subjects have signed informed consent. There were no statistically significant differences between the two groups in terms of age, disease duration, and gender ( $P>0.05$ , Table 1), confirming comparability between the two groups.

### Criteria for patient inclusion and exclusion

Patients enrolled were all confirmed as PT by smear, X-ray and tuberculin tests in our hospital with the age  $> 18$  and active cooperation with the test. Patients were excluded based on the following criteria: tumors, cardio-cerebrovascular diseases, autoimmune defects, other infectious diseases or organ dysfunction; pregnant and lactating patients; referrals; history of surgery, radiotherapy and chemotherapy within six months of admission; drug allergies.

### Methods

After admission, all patients were given corresponding ATT according to their condition, and the treatment principles were strictly in accordance with PT treatment guidelines. Routine nursing included ward environment nursing, medication instruction, diet guidance, etc. After discharge, telephone visits were made to understand patient compliance with medication and their recovery, and to remind patients to return to the hospital regularly for reexamination. Patients were followed up twice within the first month after discharge and once every month thereafter. All-in-

one nursing care: an all-in-one nursing care team was established, consisting of attending physicians, head nurses and responsible nurses. As the responsible team leader, the attending physician was responsible for total quality control and overall coordination, and developed nursing and follow-up plans with the head nurse according to the patient's condition. I. The responsibilities of doctors and nurses were clarified, and the treatment objectives were jointly formulated. Besides, attention was paid to patients' medical needs and living needs, and the treatment and nursing services were standardized throughout the patient's hospitalization. During the period of hospitalization, the working mode of 8-hour shifts and 24-hour responsibility system was established. The responsible nurse cooperated with the doctor to find out the biological pathogenic factors and psychological factors of the patient, so as to facilitate the doctor to completely eliminate the causes and improve the therapeutic effect. II. According to the patient's acceptance ability and communication mode, the nursing staff patiently explained the occurrence and development of PT, treatment methods, complications and other related knowledge to patients, so that they had a more comprehensive understanding of the disease. Besides, the importance of adhering to drug therapy for the prognostic recovery of PT was highlighted, which is conducive to enhancing patient cooperation with treatment. III. Patients' psychological status was assessed and the communication with patients was strengthened, so as to eliminate the pessimistic and negative emotions caused by the disease. Moreover, the family members were encouraged to care more about the patients, and successfully treated cases were shared to build up patients' confidence in treatment and recovery. IV. Under the guidance of specialists, the nursing staff carried out the prevention and nursing of PT complications, and instructed patients to take medication on time according to the doctor's advice. For those with symptoms of hemoptysis or pneumothorax, first-aid materials were prepared in advance, patients were informed to keep the lateral position as far as possible, and the hemoptysis was cleaned up in time. For patients at risk of recurrent hemoptysis, bronchiectasis inhibitors were administered and inspection was strengthened. V. A patient communication group was set up, where PT-related knowledge was pushed daily. Patients and their families could also timely communicate with medical staff in the communication group when they encounter problems during treatment. In addition, the recovered PT patients were invited to join the communication group for peer guidance and education. Moreover, a health manual was issued 3 days before discharge, and patients and their families were instructed to read it carefully. VI. Within 3 months after discharge, the responsible physician and nurse conducted telephone follow-ups (once every two weeks) to understand the patient's recovery, answered the patient's questions, told the patient the importance of taking medication as prescribed by the doctor for physical

Table 1. Clinical baseline data.

Group	n	Age	Duration of disease (d)	Male	Female	Hematogenous PT	Infiltrative PT	Tuberculous pleurisy
Control	37	43.97±16.10	67.27±28.78	29 (78.38)	8 (21.62)	7 (18.92)	26 (70.27)	4 (10.81)
Research	37	43.22±15.17	70.57±37.68	29 (78.38)	8 (21.62)	5 (13.51)	31 (83.78)	1 (2.70)
t or $\chi^2$		0.206	0.423	1.000			2.572	
P		0.837	0.673	1.000			0.276	

recovery, and encouraged family members to supervise the patient's implementation. Patients were given a 30-minute health education on their return to the hospital for re-examination, further emphasizing the importance of following the doctor's advice to take medicine on time.

### Assessment of cure

Clinical cure: sputum culture results remained negative for more than 1 year. X-ray cure: complete absorption, fibrosis, calcification or stabilization of the lesion. Recurrence: enlargement of lung lesions and obvious activity of lesions; phlegm bacterium-positive conversion; recurrence of respiratory clinical symptoms.

### Treatment compliance survey

Statistics were made of patients' adherence to medical prescriptions and regular reexamination, and the rate of medication compliance (number of cases with prescribed medication/total cases  $\times 100\%$ ) and regular reexamination rate (number of cases with regular reexamination/total cases  $\times 100\%$ ) of the two groups were calculated.

### Awareness of disease prevention and treatment

The survey was conducted by using our self-made PT awareness questionnaire, investigating patients' awareness of the clinical manifestations and hazards of the disease, prevention methods, the importance of regular check-up, the influence of the disease on psychological state, the importance of medication according to the doctor's advice, adverse drug reactions and the influence of the disease on living habits and behaviors. The higher the score, the higher the awareness of patients on disease prevention and treatment.

### Investigation of psychological status

Patients' psychological status was assessed using the Self-rating Depression/Anxiety Scale (SAS/SDS) (12). The standard score was calculated as the total score  $\times 1.25$ , with higher scores indicating a more serious psychological status of depression/anxiety.

### Quality of life (QOL) survey

We also evaluated patients' QOL using the Quality of Life Questionnaire core 30 (QLQ-C30) (13). The survey was divided into a functioning scale and a symptoms scale, with a score range of 100 and the score in direct proportion to the state of the field.

### Inflammatory reaction examination

Three milliliters of peripheral blood were sampled from patients at 6 months and 12 months after nursing to quantify the levels of inflammatory factors interleukin-4/6/10(IL-4/6/10) and tumor necrosis factor- $\alpha$  (TNF- $\alpha$ ) by enzyme-linked immunosorbent assay (ELISA). The kits were purchased from Beijing Sobolite Biotechnology Co., Ltd. and the operation was carried out in strict accordance with the kit instructions.

### Statistical methods

This study used SPSS22.0 software to statistically analyze the data, with the counting and measurement data represented by (%) and ( $\chi \pm s$ ), respectively. To identify the presence of statistical significance denoted by  $P < 0.05$  between groups, the Chi-square test and the independent

sample t test were used for counting and measurement data, respectively.

## Results

### Comparison of cure status

Comparing the PT cure, it can be seen that RG and CG were similar in the clinical cure rate ( $P > 0.05$ ), but the X-ray cure rate was higher and the recurrence rate was lower in RG compared with CG ( $P < 0.05$ , Tab 2).

### Comparison of treatment compliance

According to statistics, the medication compliance rate and regular reexamination rate of RG were 97.30% and 100.0%, respectively, which were statistically higher compared with CG ( $P < 0.05$ , Tab 3).

### Comparison of awareness of disease prevention and treatment

No evident difference was identified between groups in terms of the awareness level of disease prevention and treatment before nursing ( $P > 0.05$ ). Whereas, markedly enhanced awareness was observed in both groups after nursing, with higher scores in all dimensions (awareness of the clinical manifestations and hazards of the disease, prevention methods, the importance of regular check-ups, the influence of the disease on psychological state, the importance of medication according to the doctor's advice, adverse drug reactions and the influence of the disease on living habits and behaviors) in RG ( $P < 0.05$ , Fig 1).

Table 2. Cure status.

Group	n	Clinical cure	X-ray cure	Recurrence
Control	37	22 (59.46)	24 (64.86)	6 (16.22)
Research	37	24 (64.86)	32 (86.49)	1 (2.70)
$\chi^2$		0.230	4.698	3.945
P		0.632	0.030	0.047

Table 3. Treatment compliance.

Group	n	Medication compliance	Regular reexamination
Control	37	30 (81.08)	32 (86.49)
Research	37	36 (97.30)	37 (100.0)
$\chi^2$		5.045	5.362
P		0.025	0.021

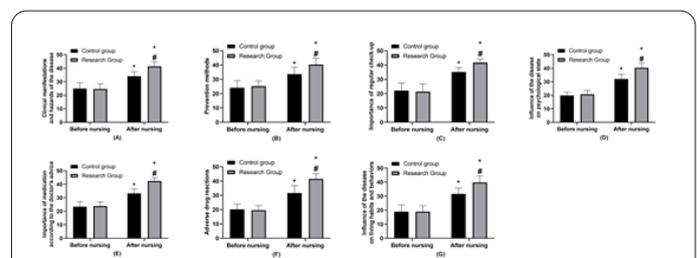
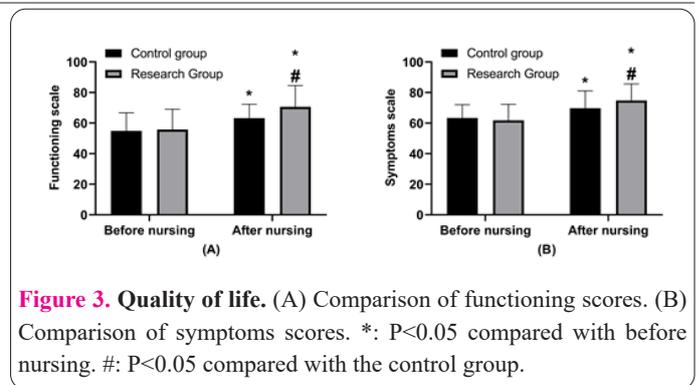
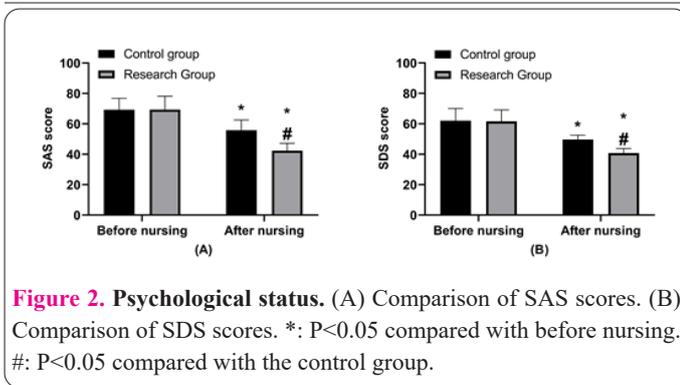


Figure 1. Awareness of disease prevention and treatment. (A) Clinical manifestations and hazards of the disease. (B) Prevention methods (C) The importance of regular check-ups. (D) The influence of the disease on the psychological state. (E) The importance of medication according to the doctor's advice. (F) Adverse drug reactions. (G) The influence of the disease on living habits and behaviors. \*:  $P < 0.05$  compared with before nursing. #:  $P < 0.05$  compared with the control group.



### Comparison of psychological status

RG and CG also differed insignificantly in SAS/SDS scores before nursing ( $P>0.05$ ). Reductions in the two scores were found in both groups after nursing, with lower SAS/SDS scores in RG as compared to CG ( $P<0.05$ , Fig 2).

### Comparison of QOL

The QOL assessment by QLQ-C30 showed no inter-group differences in terms of functioning and symptoms scales before nursing ( $P>0.05$ ); whereas, the scores of both groups increased after nursing, with the scores of functioning and symptoms scales in RG being ( $70.6\pm 13.9$ ) and ( $74.8\pm 10.8$ ), respectively, higher than those in CG ( $P<0.05$ , Fig 3).

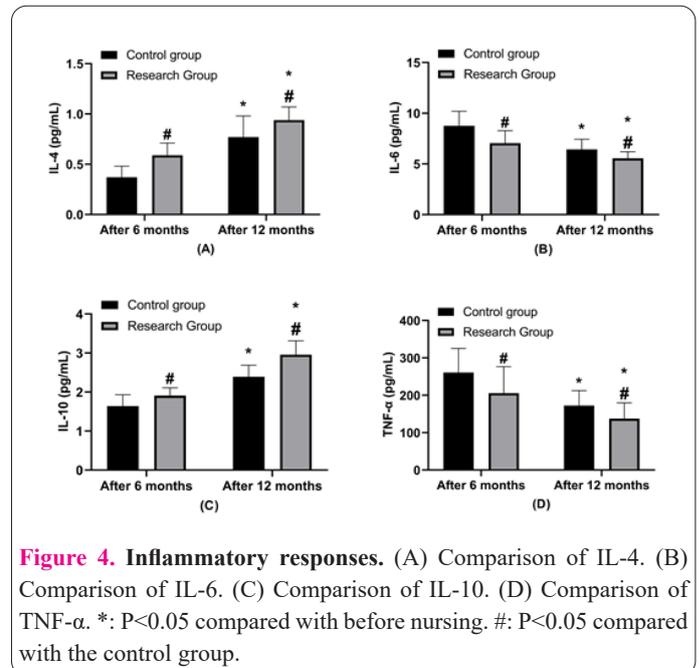
### Comparison of inflammatory responses

At last, the test results of inflammatory factors showed that IL-4 and IL-10 were higher while IL-6 and TNF- $\alpha$  were lower in RG versus CG at 6 and 12 months after nursing ( $P<0.05$ ). And compared with the levels at 6 months after nursing, IL-4 and IL-10 levels were higher in the two groups at 12 months after nursing, while IL-6 and TNF- $\alpha$  were lower ( $P<0.05$ , Fig 4).

### Discussion

The difficulty of PT treatment lies in the inability to provide long-term professional medical services, as the treatment and rehabilitation is a lengthy process that is mostly completed outside the hospital (14). The traditional model of care can no longer meet the needs of patients due to the untimely communication of medical information and the closed communication with patients (15). All-in-one nursing care is a new nursing model. It is patient-centered, emphasizes timely communication between physicians and nursing staff, and can greatly meet the treatment needs of PT patients through objective and detailed assessment of patients' conditions through full cooperation and tacit cooperation (16). By exploring the application effect of all-in-one nursing care for PT patients, this study has important implications for the future treatment of PT.

The experimental results showed a higher X-ray cure rate and a lower recurrence rate in RG compared with CG, suggesting that all-in-one nursing care can improve the therapeutic effect of PT to some extent. Similarly, we found certain enhancements in the clinical efficacy of patients with intestinal stress syndrome after the use of all-in-one nursing care (17), which can support the results of this experiment. In addition, observing patients' treatment compliance, awareness of disease prevention and treat-



ment, and psychological status, we found the better performance of all the above aspects in RG, indicating that all-in-one nursing care can improve the treatment effect of PT by improving the treatment compliance and disease awareness of PT patients and improving their mental state. Under the all-in-one, nursing care model, the collaboration between nurses and doctors can be greatly enhanced to improve patient compliance in the follow-up process. On the other hand, PT patients will face long-term isolation and social biases during long-term treatment, as well as the pain caused by the disease, resulting in their susceptibility to negative emotions such as anxiety, depression, and inferiority, which not only affect the treatment compliance, but also reduce their self-management awareness that eventually leads to poor outcomes (18). In all-in-one nursing care, the negative emotions of patients are gradually eliminated by strengthening emotional care and reasonable psychological interventions, so that patients can regain hope and motivation for recovery, which facilitates the smooth progress of treatment (19). Meanwhile, through informed education, patients can have a deeper understanding of the impact and threats caused by PT as well as precautions in the treatment process, which not only strengthens patients' self-care ability, but also gradually draws closer the relationship between doctors and patients in the communication process, thus subtly enhancing patients' treatment compliance (20). While carrying out the nursing responsibility system, the doctor in charge and the nurse develop the nursing plan together, and the

doctors and nurses coordinate and cooperate, which promotes the patients' recovery to the greatest extent, saves hospitalization expenses, satisfies the patients' health needs, and improves the working efficiency and enthusiasm of the medical staff, all of which contribute to improved overall medical quality and patient outcomes (21). Unsurprisingly, RG had a more significant improvement in the prognostic QOL, which once again emphasizes the important application value of all-in-one nursing care in PT in the future. In the pathogenesis of PT, inflammation is the basis of all kinds of pathological injuries (22). Among them, IL-6 and TNF- $\alpha$ , as pro-inflammatory factors, can induce the differentiation of Th0 cells into Th1 cells and activate effector and cytotoxic T cells. And IL-4 and IL-10 are anti-inflammatory factors that inhibit the proliferation of *Bacillus subtilis* combined with Divergent Bacteria and suppress its infection condition. Therefore, an increase in the level of pro-inflammatory factors and a decrease in the level of anti-inflammatory factors mark the aggravation of PT (23). So we detected changes in inflammatory factors in both groups during the treatment process. Lower levels of inflammatory factors were determined in RG compared with CG at 6 months and 12 months after nursing. It demonstrates that the improved quality of nursing services provided by all-in-one nursing care through the above all-round improvements will also be directly reflected in the inhibition of the increased inflammatory response of PT, suggesting the promising application prospects of all-in-one nursing care.

However, given the small number of cases included in this study, the possibility of statistical contingencies cannot be ruled out, which requires us to carry out a multi-hospital joint trial as soon as possible and increase the number of research cases for validation. Second, we need to follow up on the subjects of this study for a longer period of time to further evaluate the impact of all-in-one nursing care on the long-term prognosis of PT patients.

All-in-one nursing care can effectively enhance the level of treatment compliance and awareness of disease prevention and treatment of PT patients, improve their psychological state and QOL, and reduce the risk of inflammation, thus improving the effect of ATT, which has a very high clinical application value in the future.

### Interest conflict

The research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

### Consent for publications

The author read and proved the final manuscript for publication.

### Availability of data and material

The data in this article can be obtained from the corresponding author under reasonable circumstances.

### Authors' Contribution

Yutao Zhong and Jun Ma conception and design the research, Anqi Liu, Xiaohong Yin and Rui Wang drafting and revised the manuscript, Liang Cheng, Fan Tu and Yingying Zhang collected and analyzed the data, Anqi Liu, Xiaohong Yin and Rui Wang contributed equally in this research, All authors read and approved the final submitted

manuscript.

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### Ethics approval and consent to participate

The study protocol was approved by the Ethics Committee of Wuxi Fifth People's Hospital Affiliated Jiangnan University (Approval No:2021-021-1).

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