International Journal of Mycobacteriology xxx (2016) xxx–xxx

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Efficacy and safety of quercetin and polyvinylpyrrolidone in treatment of patients with newly diagnosed destructive pulmonary tuberculosis in comparison with standard antimycobacterial therapy

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ARTICLE INFO

Article history:
Received 10 June 2016
Accepted 16 June 2016
Available online xxxx

Keywords:
Immunotherapy
Quercetin
Quercetin and polyvinylpyrrolidone
Treatment of tuberculosis
Tuberculosis

ABSTRACT

Objective/background: The objective/background of this work was to study the efficacy and safety of quercetin and polyvinylpyrrolidone (QP) in the treatment of patients with newly diagnosed destructive pulmonary tuberculosis in comparison with standard antimycobacterial therapy.

Materials and methods: The study involved 124 patients aged between 20 years and 70 years with newly diagnosed destructive pulmonary tuberculosis. Patients were allocated to two groups. The first (control) group of patients received standard antimycobacterial and pathogenetic therapy and included 31 (25.00 ± 3.89%) patients. The second (main) group of patients received QP therapy in addition to chemotherapy and included 93 (75.00 ± 3.89%) patients.

Results: Intoxication symptoms in the second group were reduced following 1.33 ± 0.15 months, whereas in the first group intoxication symptoms were reduced following 2.64 ± 0.20 months, $p < .001$.

Conclusion: Administration of QP combined with chemotherapy in patients with newly diagnosed destructive pulmonary tuberculosis resulted in a comparatively quick reduction of disease manifestation.

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Peer review under responsibility of Asian African Society for Mycobacteriology.
http://dx.doi.org/10.1016/j.ijmyco.2016.06.012

Please cite this article in press as: D Butov et al. Efficacy and safety of quercetin and polyvinylpyrrolidone in treatment of patients with newly diagnosed destructive pulmonary tuberculosis in comparison with standard antimycobacterial therapy. Int. J. Mycobacteriol. (2016), http://dx.doi.org/10.1016/j.ijmyco.2016.06.012

Introduction

Tuberculosis (TB) is a re-emerging global public health problem, the incidence of which has increased in the Ukraine, as well as in other countries [1].

The therapeutic outcome in patients with pulmonary TB with bacterial excretion remains insufficient despite high efficacy of chemotherapy [2–4]. In 2013, in Ukrainian newly diagnosed patients, the frequency of cessation of bacterial excretion was 63% [5]. Thus, 37% of patients are contagious, which is favorable for TB circulation in a population [5]. In addition, the number of patients with primary drug-resistant *Mycobacterium tuberculosis* (MTB) has increased recently not only in Ukraine but all over the world [5–8]. In patients who excrete MTB, cavitary lesions are usually observed. It is impossible to achieve complete cure of a patient because without healing the cavitary lesions which are the main source of infection, allowing the maintenance of the microbial population leads to repeated bronchogenic spread of TB [9,10]. Modern regimens of antimycobacterial therapy have allowed the cessation of bacterial excretion to be reached in 67–96% of TB patients [11–13]. Development of new therapeutic technologies is one of the factors aimed to increase the treatment efficacy in patients with pulmonary TB [14]. Combined antibacterial therapy is deemed to be the main modern method for TB treatment [15,16]. Administration of antibacterial drugs is essential nowadays.

As defined by the World Health Organization, effective treatment results in the cessation of bacterial excretion without consideration of destruction healing in the lungs. Unhealed cavitary lesions are considered as residual changes [17,18]. However, it was shown [19–21] that unhealed cavitary lesions may cause TB recurrence under short courses of chemotherapy associated with no clinical and X-ray signs of TB improvement. Over the past years, TB recurrence tends to increase. Thus, the mortality rate related to TB recurrence increased by sevenfold [22,23].

Thus, the introduction of standard treatment regimens recommended by the World Health Organization does not provide a significant increase in the effectiveness of treatment [1].

Gaps in the understanding of the pathophysiologic networks between the human body and MTB is one of the reasons for low treatment efficacy. Consequently, combined therapeutic approaches aim to inhibit MTB and block the expansion of infected tissues. Thus, we should consider how to preserve unaffected tissues from further destruction and prevent any consequences related to TB.

When both myocardial hypoxia, triggered by the destruction of lung tissue, and TB progress, cardiopulmonary failure develops and may subsequently lead to the patient's death. Restoration of respiratory function in pulmonary TB is an essential hallmark for clinical cure, and medical and social rehabilitation of patients with respiratory diseases.

Regulation of the immune system in combined antibacterial therapy was found to be essential for higher efficiency of administered therapy [24–27]. Intensive antibacterial therapy reduces intoxication and improves the patient's general condition but does not reduce immune system impairment. Lung tissue destruction and immune system violations lead to further progression of inflammation [28,29]. TB outcome depends on the immunobiological status of the patient, as well as the complicated symbiotic interaction between MTB and the human body [30,31].

Every TB type is associated with immunopathological inflammation caused by the violation of microcirculation and trophopathy of lung tissue that may be complicated by matrix destruction, caseous mass excretion through the bronchi, and destructed region generation. This worsens the course of TB and may lead to partial or complete lung dysfunction if effective treatment is not administered. It was demonstrated that a new effective complex treatment in therapeutic conditions is required [28,32,33]. It was shown that treatment is primarily aimed at MTB elimination. There is no data available regarding the administration of therapy leading to lung tissue preservation through limiting pathological changes and matrix destruction prevention as well as rapid alleviation of intoxication syndrome associated with immune system restoration. We investigated the advantages of quercetin combined with polyvinylpyrrolidone (QP). QP is a capillary stabilizing agent and antioxidant (bioflavonoids) with immunomodulatory activity. We have shown that QP administration in TB-infected mice results in necrosis limitation from spreading to unaffected tissues [34]. Therefore, it allows localizing necrotic changes, limiting the pathological process, and preserving the affected lung. The fact that QP can influence the inflammatory process through necrosis limitation inspired us to investigate QP efficacy in TB patients.

Thus, the aim of our study was to investigate the efficacy and safety of QP in patients with newly diagnosed destructive pulmonary TB (NDTB) compared with standard antimycobacterial therapy.

Materials and methods

Patients

The study involved 124 patients with NDTB who were aged between 20 years and 70 years. All patients who presented with NDTB were enrolled in this study.

The patients were allocated to two groups. The first (control) group of 31 (25.00 ± 3.89%) patients received standard chemotherapy. The second (main) group of 93 (75.00 ± 3.89%) patients received QP therapy in addition to standard chemotherapy.

The first group included 27 (87.10 ± 6.02%) men and four (12.90 ± 6.02%) women. The second group included 64 (68.82 ± 4.80%) men and 29 (31.18 ± 4.80%) women. The difference between sex and age in both groups was statistically insignificant ($p > .05$).

All study patients presented with the active form of pulmonary TB. The most common symptoms were prolonged heavy cough, pain in the chest, subfebrile temperature fever, profuse night sweats, fatigue, dyspnea, and loss of weight and decreased appetite.

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