Application and Curative Effect of Silver Nanoparticles in Treating Allergic Rhinitis

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Abstract. Because of the exceptional antibacterial properties of silver nanoparticles, silver nanoparticles were widely used in the field of medicine. The water antibacterial gel sprays of silver nanoparticles, which silver nanoparticles were used as the main component, were widely used in the treatment of allergic rhinitis. In this paper, the properties of silver nanoparticles were widely expounding. Also the clinical efficacy of water antibacterial gel sprays of silver nanoparticles in treating allergic rhinitis was studied by the form of clinical research. The clinical research found that the water antibacterial gel sprays of silver nanoparticles had very good curative effect in treating allergic rhinitis.

1. Introduction
Silver nanoparticles are metallic silver elementary substances whose particle size is the level of nanometer. The particle size of silver nanoparticles are about twenty-five nanometer. Silver nanoparticles have intense inhibition and kill effect to dozens of kinds of pathogenic microorganism, such as Escherichia Coli, Gonococcus, Chlamydia Trachomatis, and so on. What's more, the antibacterial properties of silver nanoparticles have no drug resistance. Cotton socks which consist of silver nanoparticles and combed cotton fiber have good effect of antibiosis and deodorization. For the moment, silver nanoparticles are widely used in the fields of conductive coating, medicine, green household appliances and furniture products, catalytic material, new energy, electroplating industry [1-2], and so on.

Allergic rhinitis (AR) is a chronic non-infectious disease which is mediated by IgE and occurs in the allergen-sensitive individuals. The main characteristics of allergic rhinitis are nasal hyper-responsiveness, increased secretion, infiltration of inflammatory cells, remodeling of epithelial cells. The classical symptoms of allergic rhinitis are sneeze, snot which like clear water, nose itches and nasal congestion. The quality of life of patients is seriously affected by allergic rhinitis. In recent years, study have found that the prevalence rate of allergic rhinitis increases significantly. Allergic rhinitis affects about forty percent of the global population. Now allergic rhinitis is regarded as a health problem of the worldwide. The prevalence rate of allergic rhinitis in our country is about four percent.
to thirty-eight percent [3]. Allergic rhinitis brings great burden of disease to our country. In the year of 2008, allergic rhinitis and its impact on asthma (ARIA) divided allergic rhinitis into two categories according to the duration of symptoms: Intermittent allergic rhinitis and persistent allergic rhinitis. The symptoms of intermittent allergic rhinitis continue less than four days a week or less than four weeks a year, while the symptoms of persistent allergic rhinitis continue more than four days a week and more than four weeks a year [4].

The water antibacterial gel sprays of silver nanoparticles, which silver nanoparticles are used as the main component, are widely used in the treatment of allergic rhinitis. In this paper, the clinical efficacy of water antibacterial gel sprays of silver nanoparticles in treating allergic rhinitis was studied by the form of clinical research, in order to find whether the water antibacterial gel sprays of silver nanoparticles have good curative effect in treating allergic rhinitis.

2. Clinical data

2.1. Commonly data

All sixty patients were came from Affiliated Hospital of Shandong University of Traditional Chinese Medicine, and visited the department of ENT during the period from March 2017 to January 2018. All sixty patients were diagnosed as allergic rhinitis. All sixty patients were randomly divided into two groups. Thirty cases in treatment group, and there were fourteen males and sixteen females. The Age was from eighteen to sixty-five years old. Also, there were thirty cases in control group, with fifteen males and fifteen females. The Age was from eighteen to sixty-five years old, too. The age, sex, case history, course of disease and clinical manifestation of the two groups had no significant differences \((P > 0.05)\). There had comparability of treatment group and control group.

2.2. Diagnostic criteria

According to the relevant content of “principles of diagnosis and treatment of allergic rhinitis and recommendation plan”.

2.2.1. Medical history

Enquiring about the medical history in detail. Analyzing the onset time and inducing factors of symptoms. Observing whether the patients have asthma. The purpose is to assess the severity of symptoms. There are at least three items in four symptoms of nasal itching, sneezing, nasal secretion and nasal obstruction. For patients with perennial allergic rhinitis, the onset time of symptoms is accumulative up to half an hour to one hour per day.

2.2.2. Inspection

Nasal examination shows that the nasal mucosal is pale and edematous. Eyelid swelling can occur if the symptoms are serious. During the attack of allergic rhinitis, the smear of nasal secretion and (or) the scraper of conjunctiva will be found that the eosinophil test is positive. The reaction of allergen skin test is positive, or at least one kind of allergens shows \((++)\) or more than \((+++)\). If there are conditions, serum or nasal secretion specific IgE test can be done. When necessary, allergen nasal mucosa provocative test should be done.

2.3. Statistical processing

Statistical software SPSS17.0 was used for statistics, and the enumeration data among groups were checked by the \(\chi^2\) test.

3. Methods of treatment

The patients in control group were given Xin Qin tablets (Sichuan Zhi Yuan Guang He Pharmaceutical Co., Ltd. Approval number for drug production Z20050204) orally, three times every day, two tablets every time, and two weeks were a course of treatment. The patients in treatment group were given water antibacterial gel sprays of silver nanoparticles, also called Bang Bi Jing (Jilin Bang An Bao Medical Equipment Co., Ltd. Approval number for drug production Z22020808) to spray nose.
Spraying every nostril one or two times, two times every day, and two weeks were a course of treatment. The patients in control group were also given Xin Qin tablets orally, and the usage is the same as that in the control group. Comparing the curative effects of control group and treatment group at the end of a course of treatment.

4. Standard of curative effect and treatment results

4.1. Standard of curative effect
According to the relevant content of “diagnostic criteria for TCM syndromes” and “principles of diagnosis and treatment of allergic rhinitis and recommendation plan”.
For the purpose of observation the curative effect easily, the following score criteria is formulated:

4.1.1. Methods of symptom score.

| Grading score | Sneezing * | Runny nose △ | Nasal congestion | Nasal itching |
|---------------|------------|--------------|-----------------|--------------|
| 1 point       | 3-5        | ≤4           | Conscious feeling| Discontinuous|
| 2 points      | 6-10       | 5-9          | Intermittent or alternation | Formication, tolerable |
| 3 points      | ≥11        | ≥10          | Use mouth breathe all day | Formication, intolerable |

Notes: * Number of consecutive sneezes once; △ The number of times to blow nose every day.

4.1.2. Score standards of signs. The inferior turbinate is close to the bottom of the nasal cavity and nasal septum, the middle turbinate is invisible, or the middle turbinate mucosa appears polypoid changes or even to the extent that the formation of polypoid. The appearance of above signs can be recorded as three points. If the inferior turbinate is close to the nasal septum (or the bottom of the nasal cavity), but there are small gaps between them, two points will be recorded in this case. If the turbinate swells very light, nasal septum and middle turbinate can also be seen, one point will be recorded in this circumstance.

4.1.3. Standard of therapeutic evaluation. According to the scores of symptoms and signs to evaluate the curative effect. Score approaches as follows:

\[(a-b) / a \times 100\%\]

Notes: a= Total score before treatment, b= Total score after treatment.
≥66% is considered to be obvious effect; 65%-26% is considered to be effective; ≤25 is considered to be invalid.

The clinical research and data summary should establish the control group, including the immunotherapy. Total scores of symptoms and signs before treatment and after treatment of seasonal allergic rhinitis should be compared with the quantity and type of pollen of the year and locally. The therapeutic evaluation can be divided into two types: Short-term effect and long-term effect. The short-term effect should be evaluated at the end of the observation of specific treatment, while the long-term effect should be evaluated at one to several years later.

4.2. Treatment results

| Groups        | Number of cases | Obvious effect | Effective | Invalid | Total effective rate |
|---------------|-----------------|----------------|-----------|---------|----------------------|
| Treatment group | 30              | 18             | 9         | 3       | 90%                  |
| Control group  | 30              | 13             | 5         | 12      | 60%                  |

Comparing with control group, *P<0.05
5. Conclusion
In the medical field, silver nanoparticles mainly used for making antibacterial medicine, antibacterial medical apparatus and instruments, antibacterial plastics, antibacterial rubber products, antibacterial textiles, antibacterial clothing shoes and socks, antibacterial coatings, antibacterial ceramics, antibacterial glass, green antibacterial coatings, and so on. The application of silver nanoparticles using in medical field make the best of its antibacterial properties. Nanometre (nm) is the smallest unit of measurement after micron. One nanometre is one millionth of a millimetre, also called millimicron. One nanometre is also one over a billion. Silver nanoparticles use frontier nanotechnology to make the silver nanocrystallization. Because of the emergence of nanotechnology, the bactericidal ability of silver in the nanometre state has made a qualitative leap. Very few silver nanoparticles can produce strong bactericidal effect. Few silver nanoparticles can kill more than 650 kinds of bacteria in minutes. Silver nanoparticles have the characteristics of sterilization broadly and no drug resistance. Silver nanoparticles have the abilities of promoting the healing of wound, accelerating the growth of cells, speeding up the repair of damaged cells. Silver nanoparticles have no toxic reaction, and there are no irritation was found on the skin. All these advantages have opened up broad prospects for the application of silver nanoparticles. Silver nanoparticles are considered to be the latest generation of natural antibacterial agents [5]. Sterilization of silver nanoparticles has the following characteristics: broad-spectrum antibacterial, germicidal strongly, osmosis strongly, repair and regeneration, antiseptic persistence, and no drug resistance.

Comparing the curative effects of control group and treatment group at the end of a course of treatment, found that the water antibacterial gel sprays of silver nanoparticles have very good curative effect in treating allergic rhinitis. Other research have found that the water antibacterial gel sprays of silver nanoparticles have very good curative effect in treating elderly patients with allergic rhinitis. The water antibacterial gel sprays of silver nanoparticles could significantly improve the symptoms of sneeze, snot which like clear water, nose itches and nasal congestion [6]. Li Na have found that the water antibacterial gel sprays of silver nanoparticles have very good curative effect in treating chronic rhino-sinusitis [7]. The curative effect compared with control group have statistical significance (P<0.05). Li Xiaodong have found that the water antibacterial gel sprays of silver nanoparticles have very good curative effect in postoperative mucosa with functional endoscopic sinus surgery [8]. The water antibacterial gel sprays of silver nanoparticles could promote the regeneration and repair of injured cells, speed up the growth of tissue cells effectively, accelerate the healing of wound, reduce the formation of scar, restore the normal physiological function of nasal cilia, and improve the microcirculation around trauma tissues. The water antibacterial gel sprays of silver nanoparticles also could stabilize basophile granulocyte and mast cells. It could inhibit the basophile granulocyte and mast cells from releasing histamine, and ease the nasal discomfort.

The widely application of silver nanoparticles using in medical field make the best of its antibacterial properties. Broad-spectrum antibacterial: Silver nanoparticles can kill hundreds of kinds of pathogenic microorganisms. It can kill bacteria, fungi, trichomonad, mycoplasma, chlamydia, neisseria gonorrhoeae. The bactericidal effect of silver nanoparticles is very strong. The same bactericidal effect has been found against antibiotic resistant bacteria. Germicidal strongly: According to research findings, after the combination of silver nanoparticles with the cell wall and cell membrane of the pathogens, silver nanoparticles can enter the cells directly. After silver nanoparticles enter the cells, they rapidly combine with sulfhydryl groups of oxygen metabolizing enzymes, and make inactivation of enzyme, and then block the respiratory metabolism of pathogens, so the pathogens asphyxial death finally. Because of the unique bactericidal mechanism, silver nanoparticles particles can kill pathogens quickly at low concentration. Osmosis strongly: Silver nanoparticles particles have super permeability. Silver nanoparticles can penetrate into the skin to two millimeter, in order to sterilize quickly. Silver nanoparticles particles have very good germicidal efficacy to the deeper tissue infection, which infected by common bacteria, obstinate bacteria, drug-resistant bacteria, fungus, and so on. Repair and regeneration: Silver nanoparticles have the ability of accelerating the healing of wound, promoting the regeneration and repair of injured cells, and speeding up the growth of tissue
cells effectively, removing putrid tissues and promoting the growth of new tissues. Silver nanoparticles also have the ability of anti-inflammatory and antiseptic, improving the microcirculation around trauma tissues, accelerating the healing of wound, reducing the formation of scar, and so on. Antiseptic persistence: The production of silver nanoparticles particles utilize patented technology. There has a resist film outside the silver nanoparticles particles. Because of the silver nanoparticles particles can release gradually in the human body, so the antibacterial effect of silver nanoparticles particles is more durable. No drug resistance: Silver nanoparticles belong to non-bactericidal fungicide. Silver nanoparticles can kill all kinds of pathogenic microorganisms. The ability of bactericidal is stronger than antibiotics. Because of the unique antibacterial mechanism, silver nanoparticles in the size of ten nanometer can kill bacteria quickly and directly. Silver nanoparticles can make the bacteria lost the capacity of reproductive, so that the bacteria will be incapable to produce the next generation which is drug resistant. Silver nanoparticles can effectively prevent the repeated attacks caused by drug resistance and cure them for a long time [9].

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