Effect of nanoparticles on antibiotics concentration in the nasal mucosa in the female rats

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Abstract

Nowadays, silver nanoparticles have become crucial for biomedical purposes because of their overall anti-microbial potential effects. In this work, antibiotics, with and without silver nanoparticles, have been used in the nasal mucosa of rats. Nine rates were divided into three groups. The first group received oral amoxicillin/clavulanic acid at 80 mg/kg. The second group received oral amoxicillin/clavulanic acid at a dose of 80 mg/kg combined with silver nanoparticles at 50 mg/kg. The last group, as a control group, received distilled water and a standard diet for one month. At the end of the experiment, the rats were sacrificed, and tissues were removed from the nasal cavity.

The results demonstrated that the silver nanoparticles conjugated with amoxicillin/clavulanic acid increased their distribution in the mucosa of the nasal cavity. The experimental results were evaluated using histological examination via scanning electron microscope. This investigational outcome is essential for many clinical studies of silver nanoparticles and their medical uses in otorhinolaryngology.

Keywords: Silver nanoparticles, amoxicillin, nasal cavity, histological examination, scanning electron microscope.

Introduction

Nasal diseases, mainly because of constant irritation and contamination, such as rhinosinusitis, adversely affect the patient's satisfaction. Rhinosinusitis is a typical nasal illness that affects approximately 5-15% of the population [1]. Medicines like anti-microbial agents, nasal douche, steroids, and nasal sprays are generally recommended for patients to minimize contamination, diminish irritation, and return the affected mucosa to the normal

respiratory epithelium [2]. One more typical therapy is a surgical treatment like endoscopic sinus surgery (ESS), which is recommended after the disappointment of traditional therapy following nasal infections, for example, constant rhinosinusitis and nasal polyposis [3].
Notwithstanding, mucosal harm is inescapable in this intercession, and these harms might prompt genuine referred to complexities like synechia, osteitis, or fibrosis, particularly for adjusted regions, for example, the front-facing break [4,5]. This can be because of a few factors, for example, metaplasia of the mucosal coating because of ongoing irritation or auxiliary injury to the mucosal tissue [6,7].
Amoxicillin is semi-manufactured penicillin, which has been viably utilized as an anti-microbial in the treatment of different bacterial diseases [8]. It has an intense enemy of bacterial impact against all gram-negative just as a large portion of the gram-positive microorganisms [9]. The medication has been joined with clavulanic acid, an inhibitor of bacterial beta-lactamases, to diminish anti-microbial resistance [10].

Materials and methds

Experimental animals:
The total number of female rats in the current study was nine, weighing from 210-250 gm, purchased from the faculty of science/university of Kufa.
Using nine female rats (*Rattus norvegicus*) weighing 200-250 gm., the animals were kept under standard conditions for one week (temperature 25-28 C° and 12 hr light-dark cycle) and allowed access to standard laboratory diet and water for acclimation after the animals were divided into three groups each group contain three animals: group one received oral amoxicillin/clavulanic acid at a dose of 80 mg/kg, the second group received oral amoxicillin/ clavulanic acid at a dose of 80 mg/kg with silver nanoparticles at a dose of 50 mg/kg and the last group as control group received distal water and standard diet for one month.
At the end of the experiment, each animal was anesthetized with the mixture of xylazine 0.1 ml and ketamine 0.5 ml, and they were scarified [11]. The nasal cavity mucosa was removed and put in formalin solution at a concentration of 10% until testing under the scanning electron microscope.

Electron microscopic examination:
The preparation procedure for the electron microscope was carried out to determine the concentration of silver nanoparticles inside the mucosal tissues [12].

Results

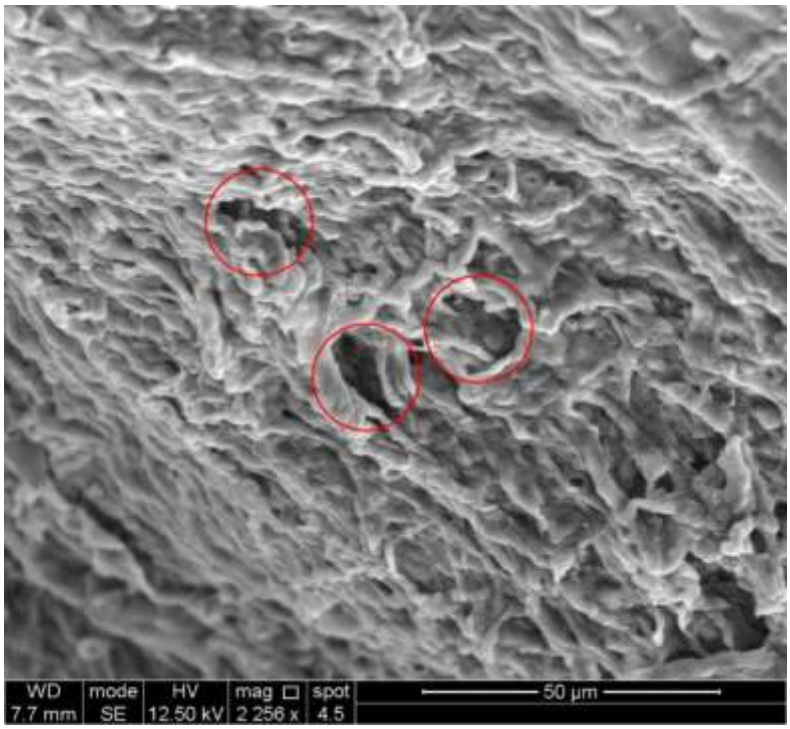

Figure 1: Micrographic image of the nasal cavity in the control group showing the opening of glandular ducts (Red cycles) and olfactory vesicles.

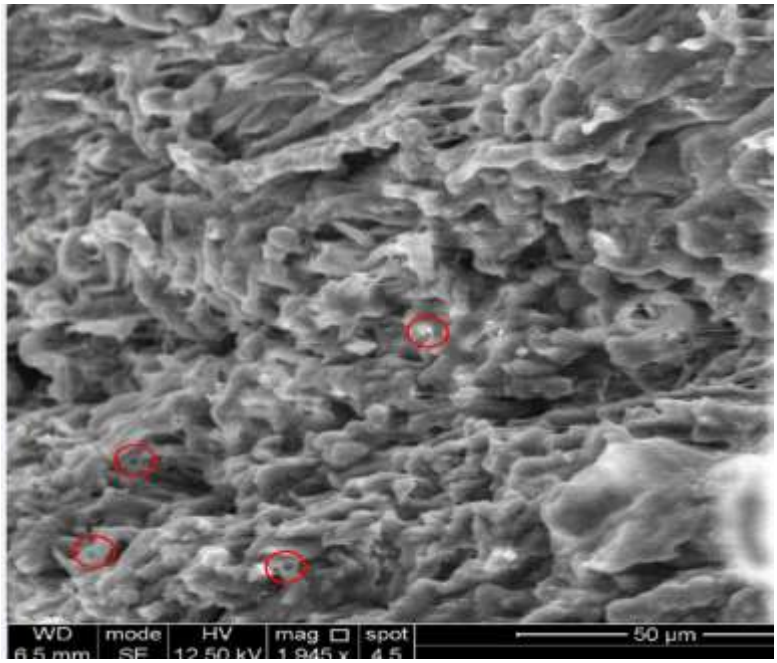

Figure 2: Micrographic image of the nasal cavity in the group of rats treated with amoxicillin-clavulanic acid with silver nanoparticles showing respiratory epithelium with the opening of the glandular duct and aggregate of silver nanoparticle

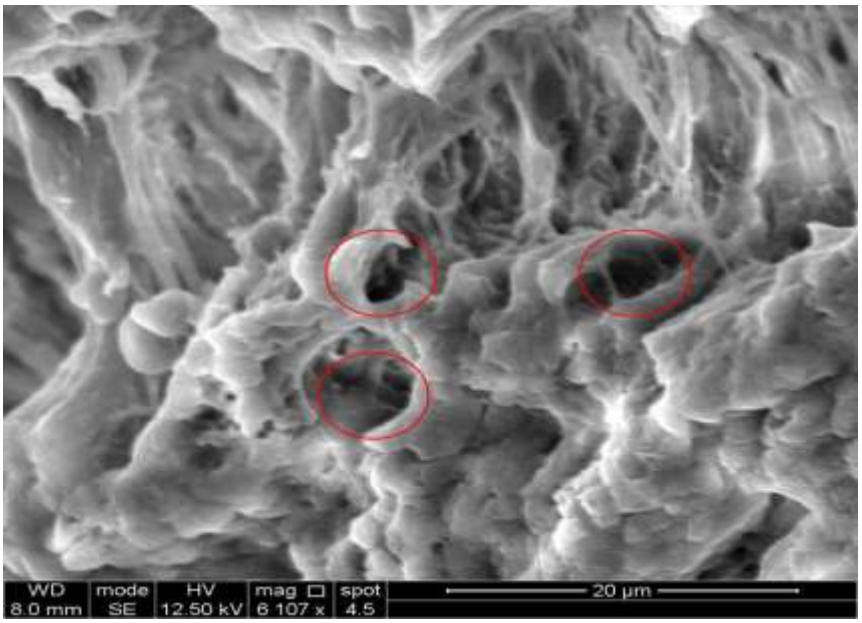

Figure 3: Micrographic image of the nasal cavity in the group of rats treated with amoxicillin and clavulanic acid with silver nanoparticles showing Conjugation of nanoparticle to an antibiotic and normal histological section of nasal cavity mucosa.

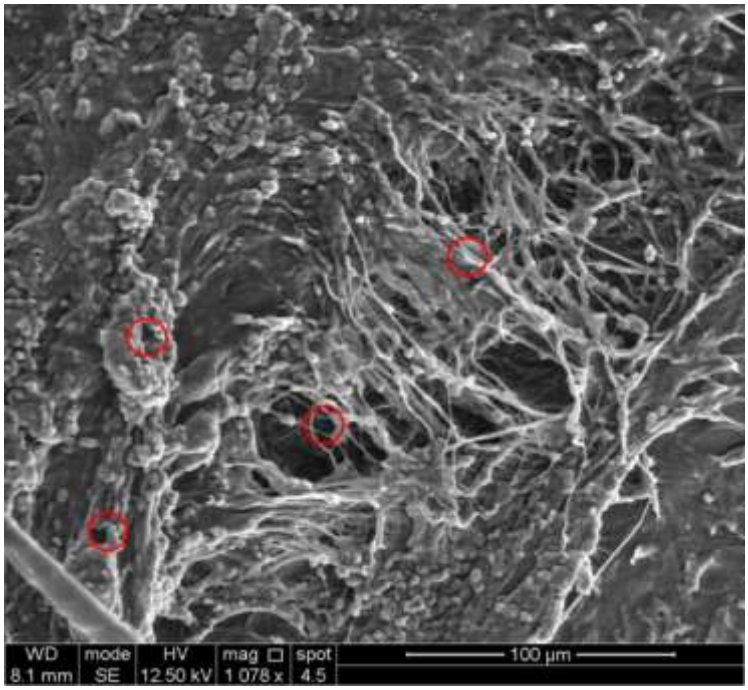

Figure 4: Micrographic image of the nasal cavity in the group of rats treated with amoxicillin-clavulanic acid showing a transitional zone into the olfactory region with olfactory dendrites (Red cycles) and olfactory vesicles

Discussion

The use of Silver nanoparticles as carries of drugs (vehicles) represents a new field for nanotechnology in medical practice, this can be explained by the tendency of these drugs that are conjugated on the surface of nanoparticles to move and concentrate selectively under the effect of an external magnetic field in the desired area of the human body [15].

In vitro studies showed that penetration of silver nanoparticles was enhanced after the use of the external magnetic field for 20 minutes, leading to a diffuse distribution of these particles into different tissues of the human nose, including the mucosa, cartilage, and bony tissues [16].
This observation opened an opportunity for using the delivery system of nanoparticles into the lamina propria of the nasal respiratory epithelium as a therapeutic option in the treatment of chronic rhinosinusitis (CRS) when the primary pathology affects basically the nasal and paranasal sinuses mucosa [17].

Also, the evidence for the use of the medical treatment of anti-microbial as an important modality in the treatment of CRS is lacking in the current literature. Some bacteria can induce inflammation in mucosal paranasal sinuses that cause severe and resistant inflammation [18].
Under specific conditions, such as acute exacerbation using, antibiotics to decrease the severity of inflammation [19]
As well as, the topical use of anti-microbial therapy and delivery of these drugs to the paranasal sinuses H were little [20-22].

Therefore our first step toward future clinical applications of the new modality of drug therapy was the evaluation of the possible Conjugation of nanoparticles to antibiotics. Preliminary results of our study have shown that the linkage of antibiotics with nanoparticles was a promising option in the treatment of respiratory diseases [23,24].

Conclusion

The results of the current study provided a basis for a new modality of drug delivery to the nasal mucosa tissues. Further experimental and clinical studies of silver nanoparticles linked with antibiotics, glucocorticoids, or some other drugs are needed, as they can add a considerable improvement to our therapeutic modalities in the treatment of chronic inflammation of the nose and paranasal sinuses.

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