Al-Azhar Med. J.(Medicine) *Vol. 52 (1), January, 2023, 275-288*
DOI: 10.21608/amj.2023.274297
https://amj.journals.ekb.eg/article_274297.html

NEBULIZED AMIKACIN AS AN ADJUVANT THERAPY IN GRAM-NEGATIVE PULMONARY INFECTIONS IN CHEST CARE UNIT

By

Mohamed H. Abd El-Wahab*, Mohamed S. El-Sayed and Abdallah S. Ayoub

Department of Chest Diseases, Faculty of Medicine, Al-Azhar University

***Corresponding author:** Mohamed Hussein Abd El-Wahab

Mobile: +02 01111370617, **E-mail:** drpulmonologist@gmail.com

ABSTRACT

Background: Aerobic Gram-negative bacilli commonly cause severe respiratory infections. Multi-drug resistant pathogens are prevalent which makes choosing the most appropriate empiric therapy extremely challenging. Nebulized Amikacin attains substantial pulmonary concentrations, and achieve outstanding bactericidal efficacy in critically ill patients.

Objective: to evaluate efficacy and safety of nebulized amikacin as an adjuvant therapy of Gram-negative pulmonary infections in chest care unit.

Patients and Methods: 60 patients with pulmonary infections caused by Gram-negative bacteria developed in hospital settings in Beni Suef University hospital from August 2019 to August 2021. They were divided into two groups: Group A received nebulized amikacin 25 mg/kg divided every 8-12h for 20 minutes and group B as a control received normal saline 5 ml at the same frequency. All participants received similar parenteral antibiotics. Aerosol treatment conducted for 7 days. Respiratory bacteriological samples obtained noninvasively.

Results: Inhaled Amikacin could a statistically significant lower respiratory rate, the serum creatinine and improvement of the sputum culture growth in group A than group B. There was a statistically significant difference between the groups regarding their length of stay and their fate. There were 83.3% of cases at the end of the 1st week of follow up transformed into no growth sputum culture among the group A

Conclusion: Inhaled amikacin had an adjuvant role in treatment of Hospital acquired pneumonia & Ventilator-associated pneumonia, as it was effective in rapid resolution of signs of respiratory infection, causing decreased bacterial load, decreased Intensive Care Unite stay and didn't cause elevation in serum creatinine.

Keywords: Inhaled amikacin, Nebulized antibiotics.

INTRODUCTION

Severe respiratory infections developed in hospital settings, i.e. hospital-acquired pneumonia (HAP) and ventilator associated pneumonia (VAP), are common *(Kalil et al., 2016)* and constitute a significant burden for healthcare systems. They are commonly caused by aerobic Gram-negative bacilli *(Martin-Loeches et al., 2014)*.

Multi-drug resistant (MDR) pathogens are prevalent in hospital settings, which makes choosing the most proper and appropriate empiric therapy extremely

difficult. The latest American *(Kalil et al., 2016)* and European guidelines *(Torres et al., 2017)* for the management of HAP/VAP patients provided recommendation to tackle this problem. The availability of dry powder antibiotic formulations and the clinical benefits observed in cystic fibrosis (CF). There has been an increasing interest in the use of inhaled antibiotics in other lower respiratory tract infections such as hospital acquired pneumonia (HAP), non-CF bronchiectasis, ventilator associated pneumonia (VAP) and chronic obstructive pulmonary disease exacerbation.

Nebulized antibiotics could deliver an effective amount of the drugs directly into the respiratory system, overcoming minimal inhibitory concentrations (MICs), while thwarting selective pressure and MDR development *(Palmer and Smaldone, 2014)*.

The systemic exposure to antibiotics and their adverse effects could be reduced. Aminoglycosides are among the available antibiotics that could be nebulized into the respiratory system. So, they have drawn much attention since they are concentration-dependent antibiotics with post-antibiotic effect and present a broad spectrum of activity. Nebulized Amikacin attains substantial pulmonary concentrations, and achieve outstanding bactericidal efficacy in critically ill patients. As intravenous administration of Amikacin is associated with nephrotoxicity and ototoxicity, it could be avoided by the use of inhaled Amikacin.

The aim of this study was to evaluate efficacy and safety of nebulized amikacin as an adjuvant therapy of Gram-negative pulmonary infections in chest care unit.

PATIENTS AND METHODS

This study included 60 patients with pulmonary infections caused by Gram-negative bacteria developed in hospital settings. Cases included hospital-acquired pneumonia (HAP), ventilator associated pneumonia (VAP) and bronchiectasis.

Cases were divided to 2 equal groups: group A treated with nebulized amikacin 25 mg/kg divided every 8-12h for 20 minutes, and group B treated with normal saline 5 ml at the same frequency. All participants received similar parenteral antibiotics. Aerosol treatment conducted for 7 days.

Inclusion criteria:

- Age >18 years old.
- Clinical suspicion of HAP, VAP or bronchiectasis.
- New onset and/or progressive pulmonary infiltrates on chest radiography.
- At least, two of three clinical features are present, i.e fever (≥38°C), leukocytosis (≥10,000/mm3) or leucopenia (<4000/mm3), and purulent tracheal secretions.
- Gram-negative bacteria on bacterial culture of airway secretion.

Exclusion criteria:

- Pregnant or lactating patients.
- History of allergy or adverse effect to Amikacin.
- Acute or chronic renal insufficiency.
- Severe immunosuppression.

- For VAP, requirement of small tidal volume MV (<6 ml/kg), PaO2/FIO2 equal to or less than 100 mm Hg.

All patients will be subjected to:

- Full history taking.
- Thorough clinical examination.
- Chest X-ray postero anterior view or computed tomography.
- Complete blood counts (CBCs) with differential.
- Serum creatinine.
- Vital signs, characters of airway secretions, and oxygenation index were recorded daily.
- Airway secretions cultivation: Bacteriological samples were performed on respiratory samples obtained noninvasively. Noninvasive methods to
- obtain respiratory samples included spontaneous expectoration, sputum induction (for HAP and bronchiectasis) and endotracheal aspiration in-patient with VAP. Detection of Gram-negative bacteria on bacterial culture of airway secretion was required.

Amikacin nebulization Procedure: Nebulization of Amikacin was performed with jet nebulizers. Daily aerosol administration of Amikacin was 25 mg/kg. The amikacin solution was nebulized with volume of 5 ml for 20 minutes. Aerosol treatment was conducted for 7 days. The amikacin solution for nebulization was prepared under sterile conditions immediately before administration to avoid possible degradation with Particle diameter 1-5 micrometer. The residual volume of amikacin solution was less than 0.2 mL. For VAP, The following ventilator settings were followed during nebulization: volume control mode, tidal volume of 8 ml/kg, constant inspiratory flow rate of 40 L/min, nebulization set during inspiration, inspiratory to expiratory (I:E) ratio ≤ 50%, and an end-inspiratory pause of 20% of the duty cycle.

Outcomes: Vital signs, oxygenation index, airway secretion quantity and character, were tracked on a daily basis. The highest temperature and the minimum oxygenation index of each day were noted. CBCs with differential, serum creatinine and lung imaging were performed at the time of randomization and by end of the treatment. Bacteriological samples were performed before the first dose and after 7 days. For VAP, length of hospital stay, length of ICU stay, days on mechanical ventilation (MV), clinical cure and mortality rate were assessed after 28 days.

Statistical analysis:

Analysis of data was performed using SPSS v. 25 (Statistical Package for the Social sciences) for Windows.

Description of variables was presented as follows:

- Description of quantitative variables was in the form of mean, standard deviation (SD).
- Description of qualitative variables was in the form of numbers (No.) and percent's (%).
- Chi-square test (or Fisher's exact) was used to detect the difference in both

groups regarding the categorical variables.

- Follow up of categorical variables was done by Mc-Nemar test
- Independent t- test was used to compare between both groups regarding normally distributed scale variables and Mann Whitney U test for not normally distributed variables.
- Paired t-test was used to detect the difference between pre and post treatment for normally distributed scale variables and Wlcoxon signed rank test for not normally distributed variables.

P-value ≤ 0.05was considered significant.

RESULTS

There were no significant differences in patients between the groups as regards age, sex, causes of ICU admission clinical, laboratory findings and O2 saturation **(Table 1)**.

Table (1): Baseline characteristics of the studied groups

Items \ Groups	Inhaled Amikacin group (NO=30)	Control group (NO=30)	P-value
Age (mean±SD)	57.8±10.3	62.1±8.1	0.073
Sex			
Males	17(56.7%)	17(56.7%)	1.000
Females	13(43.3%)	13(43.3%)	
Cause of admission			
COPD severe exacerbation	2(6.7%)	2(6.7%)	0.966
ILD acute exacerbation	1(3.3%)	0(0.0%)	
Pulmonary infection®	19(63.4%)	20(66.7%)	
severe Bronchiectasis	8(26.7%)	8(26.7%)	
Clinical examination			
Temperature (c^o)	38±0.6	37.4±2.2	0.162
Resp. rate (/min)	23±2	23±1	0.781
Laboratory finding			
TLC ($\times 10^3$)	17.5±8.5	15.2±5.8	0.433
Neutrophil (%)	71.8±12	66.2±10	0.054
Lymphocytes (%)	21.5±2.6	23.1±3.8	0.052
CRP	45.9±19.8	49.5±18.6	0.437
Serum create.	1±0.4	0.9±0.4	0.114
SO_2	83.4±7.6	85.2±6.2	0.311

There were no significant differences in patients between the groups as regards radiological findings, sputum character (abundant, purulent) and culture (most common organisms were pseudomonas and klebsialla) **(Table 2)**.

Table (2): Radiological findings, sputum character and culture

Groups / Items	Inhaled Amikacin group (no=30)	Control group (no=30)	P-value
Radiological findings			
bilateral, basal	9(30.0%)	16(53.3%)	0.314
bilateral, diffuse	15(50.0%)	10(33.3%)	
no infiltrates	2(6.7%)	2(6.7%)	
unilateral, localized	4(13.3%)	2(6.7%)	
Sputum culture			
Acinetobacter	4(13.3%)	5(16.7%)	0.082
E.coli	3(10.0%)	5(16.7%)	
Enterobacter	2(6.7%)	1(3.3%)	
Klebsiella	10(33.3%)	8(26.7%)	
Proteus	2(6.7%)	0(0.0%)	
Pseudomonas	9(30.0%)	11(36.7%)	
Sputum characters			
-abundant, purulent	18(60%)	12(40.0%)	0.152
-mild, whitish	0(0.0%)	1(3.3%)	
-moderate, purulent	11(36.7%)	17(56.7%)	
-moderate, whitish	1(3.3%)	0(0.0%)	

There was a statistically significant lower respiratory rate in the inhaled Amikacin group than the control group (P-value <0.05). Also, the serum creatinine was lower among the inhaled Amikacin group (P-value <0.05). So, no nephrotoxic effect of the inhaled Amikacin **(Table 3)**.

Table (3): Follow up the clinical examination and laboratory parameters after 7 days among the studied groups

Items / Groups	Inhaled Amikacin group (no=30)	Control group (no=30)	P-value
Temperature (c^o)	37.2±.23976	37.3±0.5	0.090
Resp. rate (/min)	17±5	21±6	0.018
TLC ($\times 10^3$)	12.4±7.5	14±6.7	0.293
Neutrophil (%)	65±8.1	66.2±5.2	0.487
Lymphocytes (%)	26.6±5.9	24.7±4.5	0.161
CRP	22.5±20.3	37.1±33.7	0.074
Serum creatinine.	0.9±0.3	1.1±0.3	0.036

There was a statistically significant difference between inhaled Amikacin group and the control group regarding their length of stay and their fate (P-value <0.05). The inhaled Amikacin group had significantly shorter duration of stay than the other group. Also, they had higher cure rate among inhaled Amikacin group, but the delayed cure and death were significantly prevalent in the non-inhaled Amikacin group **(Table 4)**.

Table (4): Comparison between both groups regarding the outcome of the study (length of stay and fate)

Groups / Items	Inhaled Amikacin group (no=30)	Control group (no=30)	P-value
Length of stay (mean±SD)	15.6±5.6	19.4±7.2	0.047
Fate			
Early cure	**15(50.0%)**	6(20%)	
Death	5(16.7%)	**9(30%)**	0.049
Delayed cure	10(33.3%)	**15(50.0%)**	

The inhaled Amikacin decreased the temperature, respiratory rate, TLC, neutrophils, and CRP significantly (P-value<0.05). Serum creatinine did not be affected by the inhaled Amikacin, while the control group showed significant improvement of the respiratory rate and CRP (P-value<0.05). Serum creatinine increased significantly after the 1st week of follow up **(Table 5)**.

Table (5): Follow up of the laboratory parameters of the inhaled Amikacin group and control group from admission till one week after admission

Time / Items	Before (no=30)	After (no=30)	P-value
Inhaled Amikacin			
Temperature (c°)	38±0.6	37.2±0.2	<0.001
Resp. rate (/min)	23±2	17±5	<0.001
TLC ($\times 10^3$)	17.5±8.5	12.4±7.5	<0.001
CRP	45.9±19.8 (median=44.5)	22.5±20.3 (median=10.5)	<0.001
Serum creatine.	1±0.4	0.9±0.3	0.417
Control group (no=30)			
Temperature (c°)	37.4±2.2	37.3±0.5	0.040
Resp. rate (/min)	23±1	21±6	0.010
TLC ($\times 10^3$)	15.2±5.8	14±6.7	0.596
CRP	49.5±18.6 (median=46.5)	37.1±33.7 (median=17)	0.042
Serum creatinine.	0.9±0.4	1.1±0.3	<0.001

The inhaled Amikacin group showed significant improvement of the oxygen saturation after 1st week of follow up (P-value<0.05) but the control group showed insignificant improvement of the oxygen saturation **(Table 6)**.

Table (6): Follow up of the oxygen saturation of the studied groups from admission till one week after admission

Time / Items (oxygen saturation)	Before	After	P-value
Amikacin group	83.4±7.5	89.8±5.3	<0.001
Control group	85.7±6.1	87.5±6.4	0.223

Inhaled Amikacin group, there was a significant improvement of the sputum culture growth at the end of the 1st week of follow up. There were 83.3% of cases transformed into no growth sputum culture. Among the control group, there was a significant improvement of the sputum culture growth at the end of the 1st week. There were 60% of cases transformed into no growth sputum culture **(Table 7)**.

Table (7): Follow up of the sputum culture bacterial growth at the end of the 1st week of follow up among the inhaled Amikacin group and control group

Sputum culture	On admission	After 1 week
Inhaled Amikacin group		
No growth	0	25 (83.3%)
Growth	30(100%)	5(16.7%)
P-value	<0.001	
Control group		
No growth	0(0%)	18(60.0%)
Growth	30(100%)	12(40.0%)
P-value	<0.001*	

DISCUSSION

Hospital-acquired pneumonia and ventilator-associated pneumonia are common infections in intensive care units, causing a high burden of disease and mortality *Rello et al., (2017)*.

For the treatment of chronic airway infections, the use of aerosolized antibiotic inhalation is established. Inhaled Amikacin therapy has been used safely and successfully to treat ventilator-associated gram-negative pneumonia in critically ill immunocompetent and immunosuppressed cancer patients *Yagi et al., (2017)*.

When the two groups were compared, the baseline characteristics showed no significant differences in age and sex so the both groups were well matched. These results are constant to the study done by *(Ailiyaer et al. 2018* and *Niederman et al. 2020)* in their average age of cases and well matching between the groups. In addition, Hospital-acquired pneumonia (HAP) is the most common infection in the intensive care unit. This infection encompasses two different entities: pneumonia associated with mechanical ventilation (ventilator-associated pneumonia or VAP) and severe

pneumonia developed during the hospital stay (*Leone et al., 2018).*

These characters were in constant to *Liu et al. (2017)* in their study about aerosolized Amikacin in VAP cases. These results were in constant to the study done by *Ailiyaer et al., (2018)* as there were no difference of the cases of the study between the groups and the main cause of admission to ICU was respiratory infections. The patients were selected properly with the same clinical examination (temperature and respiratory rate) and laboratory parameters (TLC, neutrophil, lymphocytes, CRP and serum creatinine), so there was no statistically significant difference between inhaled Amikacin group and the control group. There was no significant difference between the groups regarding oxygenation on admission as *Hakamifard et al. (2021).*

There was no statistically significant difference between inhaled Amikacin group and the control group regarding their sputum culture and characters. These results were in agreement with *Hassan et al. (2018)* in their study about nebulized versus IV Amikacin as adjunctive antibiotic for hospital and ventilator-acquired pneumonia. In addition, they were in constant to study by *Niederman et al. (2020)* as most of the Gram negative organisms were Pseudomonas and Klebsiella in the culture of patient participated in the study.

This was against the study done *Olivier et al., (2014)* which found the most concomitant organisms was Aspergillus species and the lowest organism was Klebsiella. Most of the patients had bilateral basal or diffuse infiltration of the lungs on admission, which is a common feature in diagnosis of HAP and VAP plus the clinical manifestations. It was in constant to *Papazian et al., (2020)* in their research about ventilator-associated pneumonia in adults.

In our study, we found a statistically significant lower respiratory rate in the inhaled Amikacin group than the control group. Also, the serum creatinine was lower among the inhaled Amikacin group indicating that there was no nephrotoxic effect of the inhaled Amikacin after 7 days. These results were in agreement with the study done by *Hassan et al. (2018).* It was mainly due to the pharmacokinetic characteristics of inhaled Amikacin, mainly the high pulmonary concentrations and extremely low blood concentrations of Amikacin due to the local drug delivery *Liu et al., (2017).*

There was a statistically significant difference between inhaled Amikacin group and the control group regarding their length of stay and their fate. The inhaled Amikacin group had significantly shorter duration of stay than the other group. This result was in constant to *El Fawy et al. (2020)* as they found that VAP treatment with nebulized Amikacin was associated with less ventilator and ICU days. In addition, they had higher cure rate among inhaled Amikacin group, but the delayed cure and death were significantly prevalent in the non-inhaled Amikacin group. These results were in agreement with *(Liu et al., 2017* and *Hassan et al., 2018).*

However, these results were against the study done by *Niederman et al., (2020)* as they found no treatment benefit opposes routine use of inhaled amikacin in mechanically ventilated patients with

pneumonia as they found no difference in cure rate or hospital stay in inhaled Amikacin group.

By comparison, the clinical and laboratory finding before and after treatment, we found that the inhaled Amikacin decreased the temperature, respiratory rate, TLC, neutrophils, and CRP significantly. However, serum creatinine did not be affected by the inhaled Amikacin. These results were in constant to the study by *Hassan et al. (2018)* as they found that Clinical cure, the primary outcome, was significantly different favoring amikacin nebulizer. Inhaled amikacin showed significantly lower incidence of AKI in the present trial. This is attributed to less aminoglycoside reaching the systemic circulation from one side, and due to the significantly shorter duration of the inhaled aminoglycoside, the patients were on from the other side *Lu et al., (2012)*.

The control group showed significant improvement of the respiratory rate and CRP. The serum creatinine increased significantly after the 1st week of follow up. This improvement could be due to the effect of other parenteral antibiotics given to the patients in ICU. The study done by *Niederman et al. (2020)* approve the improvement done by parenteral treatments given to cases participate in the research.

The administration of inhaled amikacin led to improve the oxygenation index of the cases when compared before treatment *Liu et al. (2017)*. This result was in agreement with *Ali. (2016)*.

The inhaled Amikacin group, there was a significant improvement of the sputum culture growth at the end of the 1st week of follow up. There were 83.3% of cases transformed into no growth sputum culture. These results were in agreement with *Ailiyaer et al., (2018)* in their study about the effect of inhaled amikacin on sputum property as they found that the bacterial count of the sputum was significantly decreased and the bacteria eradication rate significantly increased in the intervention group.

Among the control group, there was a significant improvement of the sputum culture growth at the end of the 1st week of follow up with 60% of cases transformed into no growth sputum culture. This result agreed with the study done by *Niederman et al. (2020)* as they found that the placebo group could eradicate the organisms by the effect of other emergency respiratory IV antibiotics.

CONCLUSION

Inhaled Amikacin had an adjuvant role in treatment of HAP and VAP as it was effective in rapid resolution of signs of respiratory infection, in causing decreased bacterial load, increase O_2 saturation decreased ICU stay days, higher cure rate and probably reduced cost of ICU admission. Inhaled amikacin did not cause elevation in serum creatinine.

REFERENCES

1. **Ailiyaer, Y.; Wang, X.; Zhang, Y.; Li, C.; Li, T.; Qi, Q. and Li, Y. (2018):** A Prospective Trial of Nebulized Amikacin in the Treatment of Bronchiectasis Exacerbation. Respiration.; 95(5):327-333.
2. **Ali, H. (2016):** Study of ventilator-associated tracheobronchitis in respiratory ICU patients and the impact of aerosolized antibiotics on their outcome. Egypt J Bronchol 10, 301–309.

3. **El Fawy, D. M.; Ibrahim, A. Y.; Abdulmageed, A. M. M. and El Seddek, E. A. B. (2020):** A comparative study between effect of combined intravenous and nebulized amikacin versus intravenous amikacin alone in mechanically ventilated patients with ventilator-associated pneumonia (VAP). Ain-ShamsJournal of Anesthesiology, 12(1):255-259.

4. **Hakamifard, A.; Rahmani, N.; Homayouni, A.; Khorvash, F. Abbasi, S. (2021):** Comparison of Inhaled Colistin with Inhaled Amikacin-Fosfomycin in the Treatment of Ventilator-Associated Pneumonia Caused by Extensively Drug-Resistant (XDR) Acinetobacter: A Clinical Trial. Arch Clin Infect Dis.;16(1):e111084-111092.

5. **Hassan, N. A.; Awdallah, F. F. and Abbassi, M. M.; and Sabry, N. A. (2018):** Nebulized Versus IV Amikacin as Adjunctive Antibiotic for Hospital and Ventilator-Acquired Pneumonia Postcardiac Surgeries. Critical Care Medicine, 46(1): 45–52.

6. **Kalil, A.C.; Metersky, M.L. and Klompas, M.; Muscedere, J.; Sweeney and D.A.; Palmer, L.B. (2016):** Management of adults with hospital-acquired and ventilator-associated pneumonia: 2016 clinical practice guidelines by the infectious diseases society of America and the American ThoracicSociety. Clin Infect Dis 2016;63:e61-111.

7. **Leone, M.; Bouadma, L.; Bouhemad, B.; Brissaud, O.; Dauger, S.; Gibot, S. and Chanques, G. (2018):** Hospital-acquired pneumonia in ICU. Anaesthesia Critical Care & Pain Medicine, 37(1): 83–98.

8. **Liu, C.; Zhang, Y.T.; Peng, Z.Y.; Zhou, Q.; Hu, B.; Zhou, H. and Li, J.G. (2017):** Aerosolized Amikacin as Adjunctive Therapy of Ventilator-associated Pneumonia Caused by Multidrug-resistant Gramnegative Bacteria: A Single-center Randomized Controlled Trial. Chin Med J: 130:1196-201.

9. **Lu Q, Luo R and Bodin L. (2012):** Nebulized Antibiotics Study Group: Efficacy of high-dose nebulized colistin in ventilator-associated pneumonia caused by multidrug-resistant Pseudomonas aeruginosa and Acinetobacter baumannii. Anesthesiology, 117:1335–1347.

10. **Martin-Loeches, I.; Torres, A.; Rinaudo, M.; Terraneo, S.; de Rosa, F and Ramirez, P. (2014):** Resistance patterns and outcomes in intensive care unit (ICU)-acquired pneumonia. Validation of European Centre for Disease Prevention and Control (ECDC) and the Centers for Disease Control and Prevention (CDC) classification of multidrug resistant organisms. J Inf Secur.;70:213–22.

11. **Niederman, M. S.; Alder, J.; Bassetti, M.; Boateng, F.; Cao, B.; Corkery, K.; Dhand, R.; Kaye, K. S.; Lawatscheck, R.; McLeroth, P.; Nicolau, D. P.; Wang, C.; Wood, G. C.; Wunderink, R. G. and Chastre, J. (2020):** Inhaled amikacin adjunctive to intravenous standard-of-care antibiotics in mechanically ventilated patients with Gram-negative pneumonia (INHALE): a double-blind, randomised, placebo-controlled, phase 3, superiority trial. The Lancet Infectious Diseases, 20(3): 330-340.

12. **Olivier, K. N.; Shaw, P. A.; Glaser, T. S.; Bhattacharyya, D.; Fleshner, M.; Brewer, C. C. and Prevots, D. R. (2014):** Inhaled Amikacin for Treatment of Refractory Pulmonary Nontuberculous Mycobacterial Disease. Annals of the American Thoracic Society, 11(1), 30–35.

13. **Palmer, L.B. and Smaldone, G.C. (2014):** Reduction of bacterial resistance with inhaled antibiotics in the intensive care unit. Am J Respir Crit Care Med.;189:1225–33.

14. **Papazian, L., Klompas, M. and Luyt, C.E. (2020):** Ventilator-associated pneumonia in adults: a narrative review. Intensive Care Med 46, 888–906.

15. **Rello, J.; Rouby, J.J.; Sole-Lleonart, C.; Chastre, J.; Blot, S. and Chastre, J. (2017):** Nebulisation of antimicrobial agents to mechanically ventilated patients: practical Recommendations for a safe and effective administrationda Consensus Statement. Clin Microbiol Infect Dis 18:212-225.

16. **Torres, A.; Niederman, M.S.; Chastre, J.; Ewig, S.; Fernandez-Vandellos, P. and Hanberger, H. (2017):** International ERS/ESICM/ESCMID/ALAT guidelines for

the management of hospital-acquired pneumonia and ventilator-associated pneumonia: guidelines for the management of hospital-acquired pneumonia (HAP)/ventilator-associated pneumonia (VAP) of the European Respiratory Society (ERS), European Society of Intensive Care Medicine (ESICM), European Society of Clinical Microbiology and Infectious Diseases (ESCMID) and Asociación Latinoamericana del Tórax (ALAT), Eur Respir J. :50:1–26.

17. **Yagi, K.; Ishii, M. and Namkoong, H. (2017):** The efficacy, safety, and feasibility of inhaled amikacin for the treatment of difficult-to-treat non-tuberculous mycobacterial lung diseases. BMC Infect Dis., 17: 558-564.

الاميكاسين المرذذ كعلاج مساعد فى الالتهابات الرئوية سالبة الجرام فى الرعاية الصدرية المركزة

محمد حسين عبد الوهاب، محمد صدقى السيد، عبد الله سليمان ايوب

قسم الأمراض الصدرية، كلية الطب، جامعة الأزهر

Mobile: +02 01111370617, **E-mail:** drpulmonologist@gmail.com

خلفيه البحث: بكتريا العصيات الهوائيه سالبة الجرام تسبب الالتهابات التنفسية الحادة و المسببات التى لها مقاومة متعددة للادوية هى الأشهر، وهذا يجعل اختيار المعالجه التجريبيه الاكثر مناسبه تحديا بالغاً وفى حالات المرضى بالغه الصعوبه يحقق بخاخ الاميكاسين تركيز رئوى عالى ومعه كفاءة عالية فى قتل البكتريا.

الهدف من البحث: قياس مدى كفاءة وأمان بخاخ الاميكاسين كمعالج محفز للالتهابات التنفسيه الناتجه عن بكتريا سالبه الجرام.

المرضى وطرق البحث: قامت الدراسة على 60 مريض يعانون من الالتهابات الرئوية الناجمة عن البكتيريا سالبه الجرام المكتسبة من المستشفى داخل مستشفى بنى سويف الجامعى فى الفترة من أغسطس 2019 الى أغسطس 2021و لقد تم تقسيم الحالات الى مجموعتين: مجموعة تم اعطائهم بخاخ الاميكاسين بجرعة 25 مجم/كجم كل 8-12 ساعة على مدى 20 دقيقة بينما المجموعه الأخرى أعطيت محلول ملحي بجرعة 5 ملم بنفس التردد الزمنى كمجموعه ضابطة. تلقى جميع المشاركين نفس المضادات الحيوية الوريدية. واستمر العلاج بالبخاخ الهوائي لمده 7 ايام.

نتائج البحث: أدى بخاخ الأميكاسين الى انخفاض معدل التنفس و نسبه الكريـاتينين بالدم، و تحسن فى مزرعة البلغم بدلاله احصائية فى

مجموعه الاميكاسين مقارنه بالمجموعه الضابطه وقد وجد اختلاف ذو دلالة احصائية بين المجموعتين بخصوص فترات اقامتهم فى المستشفى و مصيرهم. وفى المجموعه التى تم اعطائهم بخاخ الاميكاسين 83.3% منهم بعد اسبوع من المتابعة تحولت مزرعه البلغم الى عدم نمو أى نوع من البكتريا.

الاستنتاج: بخاخ الاميكاسين له دور محفز فى علاج الاتهاب الرئوي المكتسب من المستشفى ومن جهاز التنفس الصناعي حيث أنه فعال فى حل الاعراض التنفسية بسرعة و تقليل كميات البكتريا وتقليل مدة الاقامة فى الرعايه المركزه مع عدم حدوث زيادة فى نسبة الكرياتينين بالدم.

الكلمات الداله: بخاخ الاميكاسين و المضادات الحيويه المستنشقه.