Patterns of infections and antimicrobial susceptibility in elderly patients: Long term care based study

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Abstract

Objective: This study has been conducted to determine Patterns of infections and antimicrobial susceptibility in elderly patients admitted to long term care at a tertiary care hospital in Saudi Arabia, Eastern province to guide rationale for antibiotic use and prevent resistance.

Materials & Methods: A total of 100 specimens were collected from 100 elderly patients ≥ 60 years, both males and females admitted to long term care in a tertiary hospital in Dammam city, Eastern province, Saudi Arabia during the year 2022. Collected specimens included forty urine samples, forty sputum samples and twenty swabs from infected pressure ulcers. All collected specimens were sent for bacterial culture and sensitivity, bacterial species were determined by conventional methods and disk diffusion was used to determine the antimicrobial susceptibility pattern of the bacteria isolates after 48 hours incubation.

Results: Out of the 100 cultured specimens, 118 pathogens were detected in the whole sample where Gram-negative bacteria: primarily, Klebsiella pneumoniae (32.2%) followed by pseudomonas aeruginosa (20.3%) then Acinetobacter baumannii (14.4%) represented the most prevalent pathogens. High percentage of multidrug resistant pathogens (MDR) was detected mostly among Acinetobacter 60% followed by pseudomonas 35% then E-coli 33%. Antibiotic sensitivity was variable among different pathogens, gram negative pathogens sensitivity was generally high mainly to amino glycosides and carbapenems groups.

Keywords: Infection; Antimicrobial; Elderly; Long term care

1 Introduction

Infections are leading causes of morbidity and mortality in advanced age (1). Aging is associated with decline in physiological homeostasis which lead to alterations in organ functions, morbidity, functional decline and frailty (2,3). The most frequently involved systems in infections are respiratory and urinary tracts (1). Urinary tract infection is commonly associated with indwelling urinary catheters use in the elderly who are admitted to long term care, also prolonged recumbency increase liability to pneumonia, pressure ulcers and other complications of immobility.
Over the past 20 years, patterns of infections and their susceptibility to different antimicrobial agents has widely been changed, due to many contributing factors such as over use of antimicrobial agents, changes in socio-demography and presence of multiple co-morbidities (4).

Data regarding patterns of antimicrobial use and studies addressing old age groups are lacking, moreover, studies in this field in Saudi Arabia and Arabic regions are limited.

This study has been conducted to determine the most frequent causative agents of infections and their antimicrobial susceptibility at a tertiary care hospital in Saudi Arabia, Eastern province, Dammam city to guide rationale for antibiotic use and prevent resistance.

2 Material and methods

A total of 100 specimens were collected from 100 elderly patients both males and females admitted to long term care in a tertiary hospital in Dammam city, Eastern province, Saudi Arabia during the year 2022

Collected specimens included forty urine samples, forty sputum samples and twenty swabs from infected pressure ulcers.

Urine samples were collected from patients having evidence of urinary tract infection during routine urine analysis associated with systemic symptoms. Sputum samples were collected from patients with diagnosed pneumonia by clinical, laboratory and radiology evidence and pressure ulcer swabs from patients with discharging pressure ulcers and systemic manifestations of sepsis

All collected specimens were sent for bacterial culture and sensitivity, bacterial species were determined by conventional methods and disk diffusion was used to determine the antimicrobial susceptibility pattern of the bacteria isolates after 48 hours incubation

2.1 Statistical analysis

The collected data were coded, tabulated revised and statistical analyzed using SPSS program (version 20). Descriptive statistics were done using mean and standard deviation for numerical parametric data and by number and percentage for categorical data.

Table 1 Demonstrates the distribution of isolated pathogens among different specimens

<table>
<thead>
<tr>
<th>Isolated pathogens</th>
<th>Urine</th>
<th>Sputum</th>
<th>Bed sores</th>
<th>Total n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Klebsiella</td>
<td>16</td>
<td>14</td>
<td>8</td>
<td>38</td>
<td>32.2</td>
</tr>
<tr>
<td>Pseudomonas</td>
<td>10</td>
<td>12</td>
<td>2</td>
<td>24</td>
<td>20.3</td>
</tr>
<tr>
<td>Acinetobacter</td>
<td>2</td>
<td>10</td>
<td>5</td>
<td>17</td>
<td>14.4</td>
</tr>
<tr>
<td>Proteus mirabilias</td>
<td>4</td>
<td>7</td>
<td>4</td>
<td>15</td>
<td>12.7</td>
</tr>
<tr>
<td>E-coli</td>
<td>8</td>
<td>0</td>
<td>0</td>
<td>8</td>
<td>6.7</td>
</tr>
<tr>
<td>Providencia</td>
<td>4</td>
<td>2</td>
<td>0</td>
<td>6</td>
<td>5.08</td>
</tr>
<tr>
<td>Staph</td>
<td>0</td>
<td>5</td>
<td>3</td>
<td>8</td>
<td>6.7</td>
</tr>
<tr>
<td>Strept</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>1.6</td>
</tr>
<tr>
<td>TOTAL</td>
<td>44</td>
<td>52</td>
<td>22</td>
<td>118</td>
<td>100%</td>
</tr>
</tbody>
</table>
### Table 2 Demonstrates antimicrobial sensitivity and resistance rates among isolated organisms

<table>
<thead>
<tr>
<th>Antibiotics</th>
<th>Klebsella</th>
<th>Pseudo.</th>
<th>acinto</th>
<th>E-coli</th>
<th>Proteus</th>
<th>Staph</th>
<th>Providencia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amikacin</td>
<td>45</td>
<td>20</td>
<td>12</td>
<td>65</td>
<td>54</td>
<td>NA</td>
<td>40</td>
</tr>
<tr>
<td>Gentamycin</td>
<td>37</td>
<td>27</td>
<td>12</td>
<td>63</td>
<td>65</td>
<td>NA</td>
<td>43</td>
</tr>
<tr>
<td>Sulphamexoth/trimethoprim</td>
<td>20.2</td>
<td>5</td>
<td>3</td>
<td>8</td>
<td>2</td>
<td>10.4</td>
<td>6</td>
</tr>
<tr>
<td>Tigecycline</td>
<td>18</td>
<td>10</td>
<td>5</td>
<td>9.2</td>
<td>3</td>
<td>15</td>
<td>5</td>
</tr>
<tr>
<td>Imipenem</td>
<td>10</td>
<td>30</td>
<td>15</td>
<td>30</td>
<td>20.3</td>
<td>17</td>
<td>10</td>
</tr>
<tr>
<td>Meropenem</td>
<td>9.7</td>
<td>30</td>
<td>18</td>
<td>30</td>
<td>15</td>
<td>19</td>
<td>10</td>
</tr>
<tr>
<td>Tazobactam/piperacillin</td>
<td>5</td>
<td>17</td>
<td>13</td>
<td>4.3</td>
<td>15</td>
<td>20</td>
<td>2</td>
</tr>
<tr>
<td>Levofloxacin</td>
<td>5.3</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>NA</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>5</td>
<td>7</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>NA</td>
<td>0</td>
</tr>
<tr>
<td>Ceftazidime</td>
<td>8</td>
<td>4</td>
<td>20</td>
<td>5.3</td>
<td>12</td>
<td>15.5</td>
<td>6</td>
</tr>
<tr>
<td>Cefepime</td>
<td>8</td>
<td>8</td>
<td>3</td>
<td>3</td>
<td>10</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>Vancomycin</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>95</td>
<td>NA</td>
</tr>
<tr>
<td>Amoxicillin/clavulanic</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>80</td>
<td>2</td>
</tr>
<tr>
<td>Nitrofurantoin</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>0</td>
<td>13</td>
<td>1</td>
</tr>
<tr>
<td>Trixone</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>50</td>
<td>3</td>
<td>15</td>
<td>3</td>
</tr>
<tr>
<td>MDRO</td>
<td>30</td>
<td>35</td>
<td>60</td>
<td>33</td>
<td>22</td>
<td>5</td>
<td>20</td>
</tr>
</tbody>
</table>

MDRO: multidrug resistant organism/NA: not applied

### 3 Results

The study sample included 100 elderly, 50% males and 50% females. Mean age of subjects was 72.3(±4.2) years, all subjects examined had multiple co-morbidities mostly: type 2 diabetes mellitus 80%, essential hypertension 78%, old cerebrovascular stroke accounted for 75% and 40% subjects with cardiac disease.

All collected specimens were culture-positive yielding a wide range of isolated pathogens, the most commonly detected in the whole sample as demonstrated in table(1) were Gram-negative bacteria; primarily Klebsiella pneumonia(32.2%) followed by pseudomonas aeruginosa (20.3%) then Acinetobacter baumannii (14.4%) while Providencia stuartii was the least isolated gram negative pathogen(5.08%).

Staphylococcus aureus was the mainly isolated gram positive organism (6.7%).

Out of the 100 cultured specimens, a total of 118 pathogens were yielded as co-infection with more than one organism could be detected in cultured urine, sputum and bed sore samples.

Results demonstrated in table (2) showed that Klebsiella had the highest sensitivity to Amikacin (45%) followed by Gentamicin (37%), least to trixone and nitrofurantoin (1%).

While Pseudomonas showed highest sensitivity to imipenem and meropenem (30%) followed by gentamycin (27%) and least to trixone (2%)and amoxicillin/clavulanic (1%).

As regards Acinetobacter highest sensitivity was to Ceftazidime (20%) followed by Meropenem (18%) and least to trixone and ciprofloxacin (1%).

Proteus and Providencia were most sensitive to Gentamycin followed by Amikacin, lowest to nitrofurantoin and ciprofloxacin.
E. coli was mostly sensitive to Amikacin (65%) followed by Gentamycin (63%) and lowest to ciprofloxacin and amoxicillin/clavulanic (2%).

Staphylococci was mostly sensitive to vancomycin (95%) followed by amoxicillin/ clavulanic (80%) and least to cefepime (9%).

High percentage of multidrug resistant pathogens (MDR) was detected mostly among Acinetobacter (60%) followed by Pseudomonas (35%) then E. coli (33%).

4 Discussion
The present study results showed that cultured specimens yielded a wide range of isolated bacteria, the most predominant were: primarily klebsiella pneumoniae followed by pseudomonas aeruginosa then Acinetobacter while Providencia stuartii was the least isolated gram negative pathogen. As regards gram positive pathogens, Staphylococci aureus was the mainly isolated gram-positive organism.

Reviewing literature, Kumburu et al reported that gram negative isolates mainly proteus followed by klebsiella were the most predominant isolated bacteria in a hospital based study conducted on group of adults in northern Tanzania, pathogens detected were isolated from sputum, blood and wound cultures (5). Also Mashna et al reported that Gram negative infection pattern was predominantly observed in another study from Africa (6).

Recent studies have shown that higher temperatures are correlated with increased numbers of infections caused by Gram negative bacterial species (7) which can explain similarity between the current study results from Saudi Arabia and previous study results from Africa.

Another study from Asia conducted in Vietnam on patients with ventilator-associated pneumonia showed that Acinetobacter followed by klebsiella were the major isolated organisms, which comes in close agreement with our study results (8).

Regarding antibiotic sensitivity among different pathogens, it could be noticed that sensitivity among most gram negative organisms was mainly high to Aminoglycosides and Carbapenems group.

In the present study, klebsiella showed the highest sensitivity to Amikacin (45%) followed by Gentamicin (37%) while sensitivity to ciprofloxacin was only 5%

Reviewing literature, Santella et al reported in his study that klebsiella had highest susceptibility to Gentamycin (54.3%) (9).

Svanborg and Godaly, also, Bano et al reported that klebsiella had low susceptibility to ciprofloxacin which comes in close agreement with our study results (10, 11).

Our results showed that pseudomonas had the highest sensitivity to (Carbapenems; imipenem and meropenem (30%) followed by Gentamycin (27%) which closely agreed with results from Ehinmidu study results which reported highest sensitivity to Gentamicin (12).

Results regarding E.coli showed that sensitivity was highest to Amikacin (65%) and least to both ciprofloxacin and amoxicillin/ clavulanic (2%) which totally agreed with Shaeffer et al study results (13) while disagreed with Ehinmidu study which showed that E. coli strains were highly sensitive to ciprofloxacin (12).

Difference in antibiotic sensitivity patterns are due to non-standardization of hospital protocols used in treatment of different infections which lead to altered sensitivity and high resistance rates.

In our study, Staphylococci was mostly sensitive to vancomycin (95%) followed by amoxicillin (80%), closely agreeing with Bano et al study where Staph. aureus was (100%) sensitive to vancomycin (11).

A high percentage of multidrug resistant organisms (MDR) pathogens was detected in our study. MDR was defined as pathogen resistant to at least two antimicrobial agents.
MDR among Acinetobacter accounted for (60%) followed by pseudomonas (35%), E-coli (33%) then (30%) for klebsiella and (22%) for proteus.

It could be observed that, klebsiella generally which was the most prevalent pathogen showed low sensitivity rates to used cephalosporins ,penicillins and carbapenems which can be explained by presence of extended spectrum beta lactamase (ESBL) strains. Also, sensitivity of staphylococci was variable among penicillins, cephalosporins and carbapenems due to presence of methicillin resistant staph (MRSA) strains which leads to decrease in treatment options and result in severe infections and sepsis.

Bano et al reported a high antimicrobial resistance among gram-negative isolates to most tested antibiotics in his study, resistance to cephalosporins as well was observed among Klebsiella pathogens which comes in close agreement with our study results (11).

Overuse of antibiotics, non-standardization of hospital protocols, different genetic background of patients, socio-demographics and increasing co-morbidities with increasing age all contribute to emergence of resistant bacterial strains.

5 Conclusion

It can be concluded that, proper identification of causative organisms and their susceptibility patterns to antibiotics is crucial for choosing effective antibiotic therapy and to prevent the emergence of resistant strains which become one of the major challenges in medical practice.

Compliance with ethical standards

Acknowledgments

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Disclosure of conflict of interest

Authors declare that there is no conflict of interest

Statement of ethical approval

Approval was taken from the hospital General Manager.

Statement of informed consent

Informed consent was taken from patients' caregivers.

References


