Changing Antimicrobial Resistance Pattern of Isolates from an ICU Over a 2 Year Period

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Abstract

Objective: To study the changing patterns of antimicrobial resistance in gram negative bacilli esp. E. coli, Klebsiella Pneumoniae, Pseudomonas and Staphylococcus aureus isolates from a 37 bedded ICU of a private hospital.

Methods: All isolates obtained from a wide range of clinical samples (e.g.: urine, pus, blood, sputum, BAL, tracheal secretions) from ICU patients were evaluated for sensitivity patterns by Kirby-Bauer disc diffusion method.

Results: In the 2 year study period the rise in the number of gram negative isolates was proportionally high along with increase in their resistance pattern. Dramatic rise in ESBL’s has led to multidrug resistant E. coli and Klebsiella pneumoniae. Also organisms like Acinetobacter spp. and Pseudomonas aeruginosa are multiresistant making optimal therapy selection difficult. The incidence of ESBL’s has increased from 30-75% of the total isolates. The sensitivity of Pseudomonas aeruginosa to Meropenem has decreased from 90% to 60%. The antibiotic that remained most active against all gram negative organisms for 2 years was Imipenem, Piperacillin-Tazobactum and Amikacin. The positive result from this study was decrease in the number of S. aureus isolates from 25% in 2008 to 12% in 2009. The reason for this achievement was implementation of good and strict infection control practices.

Conclusion: 1) Antibiotic resistance continues to rise among hospital acquired gram negative pathogens and complicates empirical selection of antibiotics in the ICU. 2) Klebsiella pneumoniae and Pseudomonas are still the dominant organisms in the ICU. 3) Imipenem, Piperacillin-Tazobactum and Amikacin are still highly active against Enterobacteriacea. 4) Local data and strict infection control practices can only control the spread of virulent and resistant organisms.

Introduction

Antibiotics are chemotherapeutic agents that inhibit or abolish the growth of microorganisms and are developed to kill microorganisms. Microorganisms develop and disseminate resistance as a reaction to antimicrobials in accordance with the rules of physics, evolution and natural selection. In spite of considerable developments in antibiotics, antibiotherapy, science, medicine and medical care, infectious diseases and infectious complications related to resistant bacteria, such as staphylococci, respiratory pathogens (e.g., Streptococcus Pneumoniae), Gram-negative bacilli (extended release beta lactamase, as well as fungi and viruses, remain important causes of human morbidity and mortality. As stated in the very recent last call for action to the medical community from the Infectious Diseases Society of America, we are in the midst of an emerging (probably already emerged) crisis of antibiotic resistance throughout the world. Resistance to antimicrobials is mediated by mechanism like production of an enzyme, or alteration of antibiotic target site, or prevention of antibiotic access to the target site, or active efflux of antibiotics.

Material and Methods

All isolates were obtained from a wide range of clinical samples (e.g. urine, pus, blood, sputum, BAL, tracheal secretions) from ICU patients of Saifee hospital, Mumbai and were evaluated for sensitivity patterns by Kirby-Bauer disc diffusion method. These isolates were studied on the basis of site of infection, characteristics of patients, clinical signs and symptoms, antimicrobial resistance pattern, thus identified as true pathogens.

Antimicrobial Susceptibility Testing

Organisms were tested by disc diffusion method using Mueller –Hinton agar as described by CLSI (Clinical and Laboratory Standards Institute) guidelines. All antibiotic discs were obtained from Himedia Laboratories P. Ltd. E. coli ATCC 25922, Pseudomonas aeruginosa ATCC 27853 and Staphylococcus aureus ATCC 25923 strains were used for quality control.

Results

In the 2 year study period the rise in the number of gram negative isolates was proportionally high along with increase in their resistance pattern. Dramatic rise in ESBL’s has led to multidrug resistant E. coli and Klebsiella Pneumoniae. Also organisms like Acinetobacter spp. and Pseudomonas aeruginosa are multiresistant making optimal therapy selection difficult.

Total number of samples received in the year 2008 from the ICU were 1337. The cumulative isolates of all samples together were 401. Out of these 93 isolates were from pus; 130 from respiratory specimens; 78 were from urine and 101 isolates were from miscellaneous samples. Total number of samples received in the year 2009 from ICU were 2047, 716 were the cumulative isolates of all samples. Out of these 171 isolates were from pus; 269 from respiratory specimens; 155 were from urine and 121 isolates were from miscellaneous samples.

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**Discussion**

Several elements are known to influence the prescribing behaviour of clinicians; these elements may directly or indirectly contribute to the current antibiotic resistance crisis. Lack of knowledge and time, as well as prescriber beliefs and attitudes, may be just as persuasive as test results when a clinician considers prescribing an antibiotic.

In addition, patient expectations and demands may also sway some prescribers to write a prescription for an antibiotic that is unnecessary. In addition, prescribers may be unaware of local resistance patterns, and available antibiograms may not be updated appropriately or referenced by clinicians although culture and susceptibility testing methods are widely available in outpatient and institutional settings, they are often underused. As a result, broad-spectrum antibiotics are frequently prescribed inappropriately.

<table>
<thead>
<tr>
<th>Organism</th>
<th>2008 Number of isolates</th>
<th>2009 Number of isolates</th>
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<tbody>
<tr>
<td>Staph aureus</td>
<td>97</td>
<td>84</td>
</tr>
<tr>
<td>Klebsiella pneumoniae</td>
<td>103</td>
<td>243</td>
</tr>
<tr>
<td>E. coli</td>
<td>105</td>
<td>214</td>
</tr>
<tr>
<td>Pseudomonas</td>
<td>95</td>
<td>175</td>
</tr>
</tbody>
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Source: Dept of microbiology, Saifee hospital, Mumbai.

**Fig. 1**: Pie diagram showing total distribution of isolates in year 2008-09

**Fig. 2**: *Staph Aureus*: antibiotic V/s sensitivity (%)

**Fig. 3**: *K. Pneumoniae*: antibiotic V/s sensitivity (%)

**Fig. 4**: *E. coli*: antibiotic V/s sensitivity (%)

**Fig. 5**: *Pseudomonas*: antibiotic V/s sensitivity (%)

Klebsiella pneumonia is also a well established nosocomial pathogen and important cause of pneumonia and urinary tract infection in ICU setting. It has been observed that there is an increase in the number of isolates of Klebsiella from 2008 to 2009 (Table 1) and due to substantial increase in ESBLs resistance to cephalosporins has been increased in Klebsiella and E. coli while the carbapenems are still found to be more sensitive antibiotics.

S. aureus was the most common cause of SSTI contributing about 75% of all isolates. However the positive result was decrease in the number of isolates from 25% in 2008 to 12% in 2009 (Table 1) due to good infection control practices such as emphasis on handwash with regular educative session on
the same for medical and paramedical staff, regular cleaning, disinfection and fogging of critical areas within hospital, stringent MRSA screening protocols for indoor and outdoor patients as well as hospital staff, correct and regular use of Personal Protective Equipments (PPE).

Pseudomonas aeruginosa is a frequent cause of respiratory, surgical site and urinary tract infections in patients from intensive care areas. Resistance to carbapenems is of great concern as carbapenems are considered to be antibiotics of last resort to combat infections by multi drug resistant bacteria, especially in ICUs.

Carbapenem resistance to Pseudomonas has increased during the corresponding year. As per the Figure 5 and sensitivity analysis, ceftazidime should be initiated as a primary therapy, if the suspected strain is pseudomonas, before using carbapenems.

Antimicrobial resistance has emerged as an important determinant of outcome for patients in the ICU. The escalating problem of antimicrobial resistance has substantially increased overall health care cost. This increase is a result of prolong hospitalizations and convalescence associated with antibiotic treatment failures. The need to develop new antimicrobial agents and the implementation of broader infection control and public health interventions aimed at curbing the spread of antibiotic resistance pathogens. ICUs are unique because they house seriously ill patients in confined environment where antibiotic use is extremely common.

Effective strategies for the prevention of antimicrobial resistance in ICUs have focused on limiting the unnecessary use of antibiotics and strict implementation of infection control practices. Clinicians treating critically ill patients should consider antimicrobial resistance as an important part of their routine treatment plans. Careful, focused attention to this problem at the local ICU level, using a multidisciplinary intervention, will have the greatest likelihood of limiting the development and dissemination of antibiotic-resistant infections.

**Abbreviations**

AMK: Amikacin; AMOX + CLAV: Amoxicillin + Clavulenic Acid; IMI: Imipenem; MERO: Meropenem; LEVO: Levofloxacin, CEFIPM: Cefipime, CEFTRIX: Ceftriaxone; PIP-TAZ: Piperacillin-Tazobactum; TEC: Ticoplanin; LZD: Linezolide; VA: Vancomycin.

**References**