ORIGINAL ARTICLE

What Are the Roles of Carbapenems in an Institution-specific Epidemiological Antibiogram in East Trinidad?

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ABSTRACT

Objective: *To provide an overview of the development of an institution-specific epidemiological antibiogram. Emphasis was on last-line antibiotics, such as carbapenems.*

Methods: *In 2013, the antibiograms of various organisms were retrieved from the computerized database of the Microscan (Siemens Healthcare) at the Microbiology Laboratory of the Sangre Grande Hospital in East Trinidad, West Indies. These were divided into blood and urine specimen antibiograms. All the wards and hospital clinics were included. A 20% cut-off was used to determine that a particular antibiotic or antibiotic class could be used for empiric therapy. All the organisms were not chosen. Only the most common and clinically relevant organisms were chosen.*

Results: *Blood:* Escherichia coli, Klebsiella pneumonia, Proteus mirabilis: *Imipenem, meropenem, ertapenem showed greater than 80% sensitivity, respectively.* Pseudomonas aeruginosa: *ceftazidime, ciprofloxacin, gentamicin, levofloxacin and tazobactam/piperacillin showed 100%, 80%, 80%, 100% and 100% sensitivity, respectively. Urines:* E. coli, Klebsiella pneumonia, Proteus mirabilis: *Imipenem, meropenem, ertapenem, were greater than 80% sensitive.* Enterobacter cloacae: *Imipenem, meropenem were 92%, 100% sensitive.* Pseudomonas aeruginosa: *tazobactam-piperacillin and amikacin were both 85% susceptible.* Acinetobacter baumanii/haemolyticus: *All the antibiotics were above the 20% resistance threshold.*

Conclusion: *Patient-specific antibiograms and unit-specific trends (*eg, *ICU, surgical wards and outpatient clinic) can be used as a guide in patients with less severe infections. Carbapenems can still be used empirically, in East Trinidad, for sepsis.*

Keywords: Antibiogram, epidemiological antibiogram, resistance, Trinidad

INTRODUCTION

Empiric antibiotic therapy should be based on, among other things, (a) surveillance data within the hospital or community, (b) individualization, (c) the use of unit-based therapy (*ie*, based on the antibiograms and surveillance data of a particular ward) (1).

This article gives a general antimicrobial surveillance trend for urine and blood specimens. It does not provide data on all the organisms, but on the most common and most clinically significant pathogens.

Data had shown that resistance rates of 3% to 20% had been used to decide that an antibiotic is unsuitable for empiric therapy. This varied by antibiotic and type of infection, clinical, in vitro data and mathematical modelling. For this article, we will use a threshold of 20% resistance to define an antibiotic as unsuitable for the first-line therapy (2, 3).

It is important to develop guidelines which can be useful for a particular institution or country. Antibiograms in one country may differ from those of another country. Thus, the guidelines for one country or institution may not be applicable to another. This epidemiological antibiogram was prepared for a hospital in East Trinidad.

Stelling and Sosa of The Alliance for the Prudent Use of Antibiotics had indicated that in preparing epidemiologic antibiograms, if resistance rates were above

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 DOI: 10.7727/wimj.2015.225

the recommended thresholds for common and important organisms, health professionals should be particularly attentive to monitoring for treatment failures and the need to revise formularies and treatment guidelines (3). This document is intended to help other hospitals to prepare their own epidemiological antibiograms.

METHODOLOGY

Antibiograms, for the year 2013, of various organisms were retrieved from the computerized database of the Microscan (Siemens Healthcare) at the Microbiology Laboratory of the Sangre Grande County Hospital in East Trinidad, West Indies. This was divided into blood and urine specimen antibiograms. All the wards and hospital clinics were included.

A 20% cut-off was used to determine that a particular antibiotic or antibiotic class could be used for empiric therapy.

All the organisms were not chosen. Only the most common and clinically relevant organisms were chosen.

Ethical approval

Ethical approval was obtained from the Eastern Regional Health Authority's ethics committee.

RESULTS

Blood: **Gram negative bacteria:** For 2013 (a) 38, *Escherichia coli*, (b) 15, *Klebsiella pneumonia*, (c) 8, *Proteus mirabilis* and (d) 5, *Pseudomonas aeruginosa* were isolated from all the wards and departments.

Escherichia coli: Imipenem, meropenem, ertapenem and amikacin showed 100%, 100%, 95% and 92% sensitivity, respectively. All the other antibiotics exceeded the 20% resistance threshold.

Klebsiella pneumonia: Imipenem, meropenem, ertapenem and amikacin showed 100%, 100%, 93% and 100% sensitivity, respectively. All the other antibiotics exceeded the 20% resistance threshold. *Proteus mirabilis*: Imipenem, meropenem, ertapenem, amikacin, co-amoxiclav, ceftriaxone, ciprofloxacin, cefepime, cefuroxime, levofloxacin, tazobactam-piperacillin and trimetoprim-sulfametoxazole showed sensitivities of 88%, 100%, 88%, 100%, 88%, 88%, 88%, 88%, 88%, 88%, 88% and 88%, respectively. *Pseudomonas aeruginosa*: Amikacin, ceftazidime, ciprofloxacin, gentamicin, levofloxacin and tazobactam/piperacillin showed 100%, 100%, 80%, 80%, 100% and 100% sensitivity, respectively. The carbapenems were actually greater than 20% resistant for this organism.

Gram positive bacteria: For 2013 (a) 40, *S. aureus*, (b) 6, Streptococcus Group B, (c) 11, *Enterococcus* spp. and (d) 1, *Listeria monocytogenes* were isolated from all the blood cultures from all the wards and departments. *S. aureus*: Trimetoprim/sulfametoxazole, gentamicin and tetracycline were 85%, 82% and 88% sensitive, respectively. Linezolid, Synercid and vancomycin were 90%, 100% and approximately greater than 80% sensitive, respectively. Streptococcus Group B: Ampicillin, penicillin and clindamycin were 83%, 83% and 100% sensitive, respectively. *Listeria monocytogenes*: Ampicillin and penicillin were both 100% sensitive. *Enterococcus* spp.: All *Enterococcus* spp. were greater than 80% sensitive to ampicillin, vancomycin and linezolid.

Urine: **Gram negative bacteria:** For 2013 (a) 259, *Escherichia coli*, (b) 75, *Klebsiella pneumoniae*, (c) 27, *Proteus mirabilis*, (d) 20, *Pseudomonas aeruginosa*, (e) 13, *Enterobacter cloacae*, and (f) 9, *Acinetobacter baumanii/haemolyticus*.

Escherichia coli: Imipenem, meropenem, ertapenem, amikacin, gentamicin and tazobactam/piperacillin were 98%, 100%, 95%, 93%, 83%, 83% sensitive, respectively. All the other antibiotics exceeded the 20% resistance threshold. *Klebsiella pneumonia*: Imipenem, meropenem, ertapenem and amikacin were 99%, 100%, 97%, 100% sensitive, respectively. All other antibiotics exceeded the 20% resistance threshold. *Proteus mirabilis*: Imipenem, meropenem, ertapenem, amikacin, co-amoxiclav, ceftriaxone, ciprofloxacin, cefepime, cefuroxime, levofloxacin, tazobactam-piperacillin and trimetoprim-sulfametoxazole, gentamicin showed 96%, 100%, 93%, 81%, 100%, 85%, 85%, 85%, 85%, 93%, 93%, 81% and 89% sensitivity, respectively. *Pseudomonas aeruginosa*: tazobactam-piperacillin and amikacin were both 85% susceptible. All the other antibiotics exceeded the 20% resistance threshold, including the carbapenems. *Enterobacter cloacae*: Imipenem, meropenem, amikacin were 92%, 100% and 85% sensitive, respectively. All the other antibiotics exceeded the 20% resistance threshold.

Acinetobacter baumanii/haemolyticus: All the antibiotics were above the 20% resistance thresholds. The tetracyclines were most sensitive at 67% sensitivity.

Gram positive bacteria: For 2013 (a) 21, *Enterococcus faecalis*, (b) 14, *Staphylococcus saprophyticus* and (c) 11, *Staphylococcus aureus* were isolated from all the wards and departments. *Enterococcus faecalis*: Ampicillin and vancomycin were 90% and 95% sensitive, respectively. *Staphylococcus saprophyticus*: Trimethoprim/

sulfametoxazole and gentamicin were 100% and 86% sensitive, respectively.

Staphylocossus aureus: Trimethoprim/sulfametoxazole and gentamicin were 100% and 82% sensitive, respectively.

DISCUSSION

Blood: In general, carbepenems appear useful as the first-line empiric therapy, in blood stream infections, except if *P. aeruginosa* is suspected, especially if combination therapy is needed with a beta-lactam antibiotic (4, 5). Aminoglycosides or flouroquinolones may be of better use empirically for synergy. For empiric therapy, vancomycin and linezolid do not have to be the first line, empirically. Ampicillin and Gentamicin appear adequate. If *S. aureus* is suspected, vancomycin may be considered with a view to de-escalate, based on the patient's antibiogram or department-specific data.

Urine: In general, carbepenems or tazobactam-piperacillin appear useful as the first-line empiric therapy, except if *Acinetobacter baumanii/haemolyticus* is suspected. In this case, aminoglycosides or flouroquinolones may be of better use empirically for synergy. In general, trimethoprim/sulfametoxazole and gentamicin appear useful as the first-line empiric therapy for urinary tract infection caused by Gram positive cocci. Thus, vancomycin and linezolid can be reserved.

The broad spectrum antibiotics recommended in this guide should be used initially, only in critically ill patients, as Surviving Sepsis Guidelines recommend starting antibiotics within the first few hours of diagnosis of sepsis (4). Patient-specific antibiograms and unit-specific trend (*eg*, ICU, surgical wards, outpatient clinic) can be used as a guide in patients with less severe infections. Thus, this recommendation should be tailored as appropriate (1). This will help reduce the development of resistance.

Vancomycin or linezolid is recommended as empiric therapy if Gram positive organisms are suspected. This should be used in critically ill patients, as Surviving Sepsis Guidelines recommend starting antibiotics within the first few hours of diagnosis of sepsis (4). Patient-specific antibiograms and unit-specific trend (*eg*, ICU, surgical wards, outpatient clinic) can be used as a guide in patients with less severe infections.

Enterobacteriaceae, *Pseudomonas aeruginosa* and *Acinetobacter baumanii/haemolyticus* appear to have developed significant resistance. Thus, carbapenems, which should be reserved as the last-line agents, currently have to be used as the first-line agents. This is a worrying phenomenon. In fact, carbapenem-resistant Enterobacteriaciae have been highlighted by the Centre for Disease Control, Atlanta, in their publication, Guidance for Control of Carbapenem-resistant Enterobacteriaceae (7).

Institutional prevention programmes, in East Trinidad, are being implemented to prevent the development of widespread carbapenem resistance. This includes: hand hygiene compliance, antibiotic stewardship, surveillance, early identification and reporting to the ward staff and other related activities. These strategies are being implemented in a "bundled care" approach (8).

Stelling and Sosa have shown that the thresholds such as 3%, 5%, 10% and 20% can be used, this especially depends on the bacteria and antimicrobial agent being considered (3, 9). For Gram negative and Gram positive organisms used, in preparing this epidemiological antibiogram, any resistance threshold less than 20% would not have been feasible, for most Gram negative organisms. Thus, it can be seen that the problem of antibiotic resistance in East Trinidad is of great significance. It is thus recommended that a figure such as 20%, for a resistance threshold, be used initially and adjust it in 5% increments to achieve an adequate assessment of the utility of antimicrobials in a particular setting. Vancomycin and linezolid's empiric use can be preserved for bacteremia or septicemia and bacteriuria.

Lastly, we should correlate microbiological data with clinical data. This is to ensure that we treat the patients and not the culture. A patient may have a positive culture but be asymptomatic. Alternatively, a non-pathogenic bacterium may be isolated.

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