Rapid Growth-Based Detection of Carbapenem-Resistant Gram-Negative Bacteria Using the Real-Time Light-Scattering Method

Evgeny A. Idelevich
Institute of Medical Microbiology
University Hospital Münster
Domagkstr. 10
48149 Münster, Germany
Phone: 49-251-83 56993
Fax: 49-251-83 55350
E-Mail: evgeny.idelevich@ukmuenster.de

Evgeny A. Idelevich[1], Matthias Hoy[1], Matthias Borowski[2], Dennis Görlich[2], Barbara Grünastel[1], Dennis Knaack[1], Georg Peters[1], Karsten Becker[1]

[1]Institute of Medical Microbiology, University Hospital Münster and [2]Institute of Biostatistics and Clinical Research, University of Münster, Münster, Germany

Introduction

The prevalence of multidrug resistant Gram-negative bacteria is increasing worldwide. Therefore, rapid detection of carbapenem resistance is critical for early initiation of an appropriate antimicrobial treatment.

Methods

Growth-based detection of meropenem resistance was performed by the light-scattering method using BacterioScan™216R device for real-time monitoring of microbial growth (BacterioScan Inc., St. Louis, MO). Ten meropenem-resistant and ten meropenem-susceptible clinical isolates of Gram-negative rods (seven *Pseudomonas aeruginosa* and three *Klebsiella pneumoniae* isolates in each group) were used. The inoculum of 5x10^5 cfu/ml was prepared in cation-adjusted Mueller-Hinton broth. The samples were incubated in the BacterioScan instrument for 6 hours at 35°C with and without meropenem in breakpoint concentration of 2 µg/ml. Each sample was automatically measured every 3 minutes. ROC analyses were performed considering the ratio of growth trends (bacteria vs. corresponding sample with antibiotic) for all time points, where growth trends were estimated using a recently developed moving window regression procedure. Broth microdilution method was performed for determination of meropenem minimum inhibitory concentrations (MIC).

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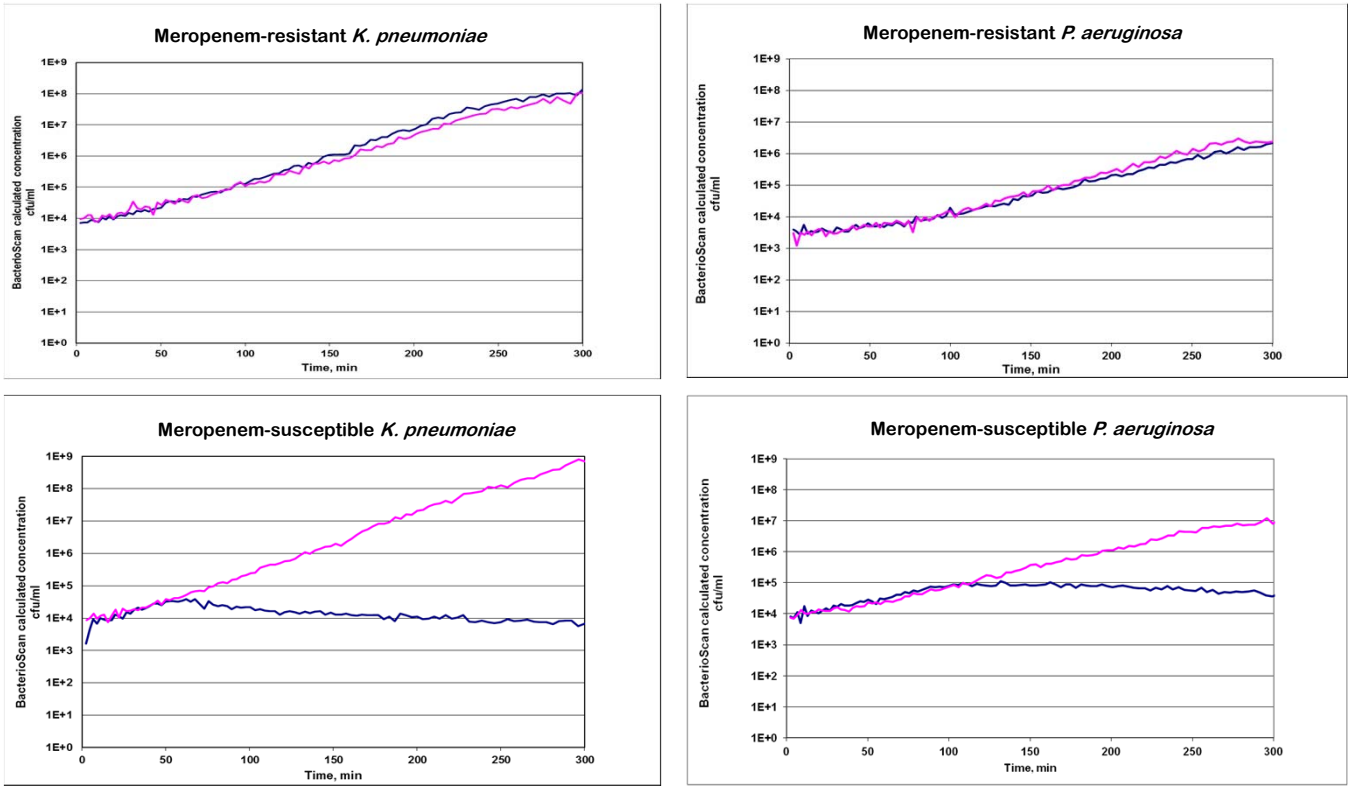

Fig. 1. The growth curves of meropenem-resistant and meropenem-susceptible *K. pneumoniae* and *P. aeruginosa*

Results

The estimated sensitivity and specificity for detection of meropenem-resistant Gram-negative bacteria achieved both 100% after 200 minutes of incubation. Due to the particularly early response of susceptible *K. pneumoniae* isolates to meropenem, the differentiation of resistant vs. susceptible isolates was possible already after 80 minutes for this species. According to the broth microdilution, MIC_{50}/MIC_{90} were 16/16 µg/ml and 0.25/0.5 µg/ml for meropenem-resistant and meropenem-susceptible isolates, respectively.

Conclusions

- **The light-scattering method is promising for the early detection of carbapenem-resistant Gram-negative bacteria**
- **The time to result seems to be particularly short for *Enterobacteriaceae***
- **The performance of this method warrants further investigation on a multitude of geno- and phenotypically diverse isolates**