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Changes in antimicrobial susceptibility of commonly clinically significant isolates before and after the interventions on surgical prophylactic antibiotics (SPAs) in Shanghai

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ABSTRACT

Surveillances and interventions on antibiotics use have been suggested to improve serious drug-resistance worldwide. Since 2007, our hospital have proposed many measures for regulating surgical prophylactic antibiotics (carbapenems, third gen. cephalosporins, vancomycin, etc.) prescribing practices, like formulary restriction or replacement for surgical prophylactic antibiotics and timely feedback. To assess the impacts on drug-resistance after interventions, we enrolled infected patients in 2006 (pre-intervention period) and 2014 (post-intervention period) in a tertiary hospital in Shanghai. Proportions of targeted pathogens were analyzed: methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant *Enterococcus spp.* (VRE), imipenem-resistant *Escherichia coli* (IREC), imipenem-resistant *Klebsiella pneumoniae* (IRKP), imipenem-resistant *Acinetobacter baumannii* (IRAB) and imipenem-resistant *Pseudomonas aeruginosa* (IRPA) isolates. Rates of them were estimated and compared between Surgical Department, ICU and Internal Department during two periods. The total proportions of targeted isolates in Surgical Department (62.44%, 2006; 64.09%, 2014) were more than those in ICU (46.13%, 2006; 50.99%, 2014) and in Internal Department (44.54%, 2006; 51.20%, 2014). Only MRSA has decreased significantly (80.48%, 2006; 55.97%, 2014) ($p < 0.0001$). The percentages of VRE and IREC in 3 departments were all <15%, and the slightest change were also both observed in Surgical Department (VRE: 0.76%, 2006; 2.03%, 2014) (IREC: 2.69%, 2006; 2.63%, 2014). The interventions on surgical prophylactic antibiotics can be effective for improving resistance; antimicrobial stewardship must be combined with infection control practices.

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Introduction

Since turn of the 21st century, the emergence of organisms with increased resistance to available antibiotics has been continuously concerned by the public.[1–4] Simultaneously, it has become a global threat to human health, provoking adverse outcomes, high care costs and prolonged hospital stays.[5] The unrestrained use of antibiotics has been implicated as a significant reservoir of the greatly changed resistance.[1,6] Thus optimizing use of antibiotics has become one of the most essential parts to contain resistance.[6,7] A study in France has showed successful control on fluoroquinolone-resistant *Pseudomonas aeruginosa* and methicillin-resistant *Staphylococcus aureus* (MRSA) by fluoroquinolone prescription restriction.[8] Similarly, another multifaceted proactive intervention program including antimicrobial stewardship has also minimized the nosocomial transmission and outbreaks of vancomycin-resistant *Enterococcus spp.* (VRE) in HongKong.[9] What's better, reports from the US and Korea have demonstrated that the monitoring on antibiotics (surgical prophylactic antibiotics (SPAs)) could reduce the antimicrobial use and length of hospital stay, improve the clinical and financial outcomes and even slow down the previously increasing antimicrobial resistance rates of some pathogens.[5,10,11]

A study once performed in China collecting 230,800 prescriptions between 2007 and 2009 has revealed excessive overprescribing, including twice as many prescriptions as recommended by the WHO.[12] Herein, a hospital-wide intervention project was launched in our hospital to improve the quality of SPAs in 2007, and the backend alerts of Hospital Information System (HIS) and a restriction system were introduced one year later.[13,14] All measures intended to minimize the unnecessary usage of antibiotics by timely feedback and prospective audit. Although they have been confirmed to enhance the appropriateness of antibiotic use and improve the quality of treatment,[13] the effects on changes in antimicrobial resistance warranted further researches. Thus we conducted the study to compare the antimicrobial resistant rates of six major nosocomial pathogens between the pre- and post-intervention periods. To our knowledge, most studies to date focused more on the rapid growth of drug-resistant bacteria due to the antibiotics abuse in China or the decreases of drug consumption due to antimicrobial stewardship.[15–18] Whether the interventions on SPAs were effective to antimicrobial resistance, however, has not been documented well in Shanghai, even in China.

Materials and methods

Setting

Ruijin Hospital is a tertiary university-affiliated hospital, located in Shanghai, a large metropolitan region in China of over 24 million inhabitants. It is a general 1800-bed hospital integrated with emergency, intensive care unit (ICU), surgery and other departments, serving approximately 115,000 patient visits per year. In addition to native residents, patients from other provinces in China also come for better medical treatment.

The study was approved by Ruijin Hospital Ethics Committee (Shanghai Jiao Tong University School of Medicine), and the Review Board exempted request for informed consent because no patient-level data were obtained.

Interventions

The intervention measures were described before.[14] Briefly, medical records of the patients prescribed SPAs (with emphasis on carbapenems, third gen. cephalosporins and vancomycin) were selective examined, for example, timing of antibiotic administration, appropriateness of the regimen and duration of SPAs. Moreover, the backend alerts of HIS and a restriction system were designed to monitor and improve the use of SPAs in line with the inclusion of assessing the use of SPAs. Ratios of adherence to the recommendations were measured regularly and timely feedback was given to surgical staffs. The surgeons were provided with systematical lectures on the rational use of SPAs, which may facilitate the propagation.

Isolates

We performed an interrupted time series study of patients with infections in 2006 (pre-intervention period) and 2014 (post-intervention period). Cases were identified from the laboratory database of the Department of Clinical Microbiology. Only the first isolate from the same species was reviewed and recorded per patient among the two periods. To evaluate the effect of interventions in SPAs on antimicrobial resistance, pathogens belonging to six major species or genus were enrolled in current study referring to the primer studies as following[1,3]: *S. aureus*, *Enterococcus spp.*, *Escherichia coli*, *Klebsiella pneumoniae*, *Acinetobacter baumannii* and *P. aeruginosa*. Antimicrobial susceptibility data, including MRSA, VRE, imipenem-resistant *E. coli* (IREC), imipenem-resistant *K. pneumoniae* (IRKP), imipenem-resistant *A. baumannii* (IRAB) and imipenem-resistant *P. aeruginosa* (IRPA) were collected. Species were identified by standard biochemical methods or the VITEK 2 compact system (bioMérieux, Marcyl'Étoile, France). The antimicrobial susceptibilities of clinical isolates were determined by the disk diffusion method according to the Clinical and Laboratory Standards Institute (CLSI) criteria or the VITEK 2 compact system (bioMérieux, Marcyl'Étoile, France) following the specifications, and results were interpreted using the CLSI criteria.[19] Variations in the susceptibility phenotype above were estimated from pre- and post-intervention periods among different departments (ICU, Internal Department and Surgical Department).

Statistical analysis

Values were presented as a percentage of the group. Pearson's chi square test was used for testing the differences of proportions and resistant rates between two groups with Fisher's exact test as appropriate. A two-tailed p value of <0.05 was regarded as statistically significant. All statistical analysis was performed by SAS 8.2 (SAS Institute Inc., Cary, NC, USA).

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