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MICROGRAVITY INCREASES THE SENSITIVITY OF A CLINICAL KLEBSIELLA PNEUMONIAE ISOLATE TO PIPERACILLIN THROUGH DECREASING THE EXPRESSION OF FOX-TYPE BETA-LACTAMASES

Abstract

Infections caused by pandrug-resistant bacteria are challenges to modern medicine. We hypothesized microgravity might increase the sensitivity of pathogenic bacteria to certain antibiotics. We cultured clinical isolates of Pseudomonas aeruginosa, Acinetobacter baummanii and Klebsiella pneumoniae under simulated microgravity and normal gravity, respectively (using rotary cell culture systems), and monitored the sensitivity of the bacteria to 12 antibiotics (Ampicillin, Piperacillin, Ceftazidime, Cefepime, Chloramphenicol, Tetracycline, Gentamicin, Tobramycin, Norfloxacin, Ciprofloxacin, Levofloxacin and Cotrimoxazole). Neither the P. aeruginosa isolate nor the A. baummanii isolate showed altered sensitivity to the tested antibiotics after 7-day microgravity exposure. However, the K. pneumoniae isolate showed increased sensitivity to Piperacillin after 7-day microgravity exposure, compared with the normal gravity condition. We further hypothesized that microgravity might increase the sensitivity of the K. pneumoniae isolate to Piperacillin through decreasing the expression of beta-lactamases. We identified the types of beta-lactamases in the K. pneumoniae isolate by PCR assays. Genes for FOX, VEB and SHV types of beta-lactamases were detected. We assayed the expression of beta-lactamases in K. pneumoniae cells cultured under simulated microgravity and normal gravity by RNA extraction, reverse transcription and realtime PCR. Decreased expression of FOX-type beta-lactamases was found in the K. pneumoniae cells cultured under simulated microgravity, compared with the normal gravity condition. This may underlie the increased sensitivity of the K. pneumoniae cells cultured under simulated microgravity to Piperacillin. This is the first study that shows short-term microgravity exposure may increase the sensitivity of pathogenic bacteria to certain antibiotics and provides a molecular mechanism. Our study suggests that microgravity has the potential to aid the treatment of infections caused by pandrug-resistant bacteria by increasing the sensitivity of the bacteria to certain antibiotics.