the preceding month. A review of respiratory care procedures revealed that when mechanical ventilators were serviced between patients, the electronic temperature probes used with servo-controlled humidifiers were wiped with inadequate disinfection. Cultures were taken of case-patient room surfaces, sinks, and ventilator equipment. *S. maltophilia* was recovered from room surfaces, ventilator expiratory circuits, and a temperature sensor that had been kept in ambient air after disinfection. Patients and environmental isolates were examined by randomly amplified polymorphic DNA–polymerase chain reaction.

Three clinical isolates and one environmental isolate had the same profile, which suggests cross-contamination or common source exposure. The outbreak was controlled by adequate disinfection of the temperature sensors. No single epidemic strain was identified, but several observations support the conclusion that the temperature probes contributed to the outbreak.

FROM: Rogues AM, Maugein J, Allery A, et al. Electronic ventilator temperature sensors as a potential source of respiratory tract colonization with *Stenotrophomonas maltophilia*. *J Hosp Infect* 2001;49:289-292.

Biofilms and Planktonic Cells of *Pseudomonas aeruginosa* Have Similar Resistance to Killing by Antimicrobials

Biofilms are considered to be highly resistant to antimicrobial agents. However, Spoering and Lewis from Northeastern University, Boston, Massachusetts, point out that strictly speaking, this is not the case. Biofilms do not grow any better than planktonic (free floating) cells in the presence of antimicrobials. Biofilms are indeed highly resistant to killing by bactericidal antimicrobials, compared with logarithmic-phase planktonic cells, and therefore exhibit tolerance. It is assumed that biofilms are also significantly more tolerant than stationary-phase planktonic cells. Spoering and Lewis conducted a study to compare, in detail, the tolerance of biofilms versus stationary- and logarithmic-phase planktonic cells to four different antimicrobial agents.

Carbenicillin appeared to be completely ineffective against both stationary-phase cells and biofilms. Killing by this beta-lactam antibiotic depends on rapid growth, and this result confirms the notion of slow-growing biofilms resembling the stationary state. Ofloxacin is a fluoroquinolone antibiotic that kills nongrowing cells, and biofilms and stationary-phase cells were comparably tolerant to it. Most cells in both populations were eradicated at low levels of ofloxacin, leaving a fraction of essentially invulnerable persisters. The bulk of the population in both biofilm and stationary-phase cultures was tolerant to tobramycin. At very high concentrations of tobramycin, a fraction of persister cells became apparent in stationary-phase culture. Stationary-phase cells were more tolerant to the biocide peracetic acid than were biofilms.

In general, stationary-phase cells were somewhat more tolerant than biofilms in all of the cases examined. The authors concluded that, at least for *Pseudomonas aeruginosa*, one of the model organisms for biofilm studies, the notion that biofilms have greater resistance than do planktonic cells is unwarranted. They further suggest that tolerance to antibiotics in stationary-phase or biofilm cultures is largely dependent on the presence of persister cells.

FROM: Spoering AL, Lewis K. Biofilms and planktonic cells of *Pseudomonas aeruginosa* have similar resistance to killing by antimicrobials. *J Bacteriol* 2001;183:6746-6751.

Outbreak of *Mycobacterium szulgai* Following Laser Eye Surgery

Laser-assisted in situ keratomileusis (LASIK) is a commonly performed procedure to correct myopia, hyperopia, and astigmatism. After a case of postoperative intracorneal keratitis infection with *Mycobacterium szulgai* occurred, investigators identified a total of 5 additional patients with this infection of the 52 who had LASIK procedures performed from June 6 to October 24, 2000. All 5 cases were identified among the 18 patients of Dr. A, and no cases were identified among the 34 patients of Dr. B. Two additional patients of Dr. A had had similar corneal lesions, but cultures were not obtained from them. The surgeons' techniques differed only in that Dr. A used a saline lavage that was chilled in a tub of ice, whereas Dr. B used unchilled saline directly from its stock bottle. Extensive environmental cultures were obtained. A culture from the drain of the source ice machine grew *M. szulgai*. Pulse-field gel electrophoresis confirmed this to be identical to all 5 clinical isolates and different from *M. szulgai* type strain (American Type Culture Collection 35799) and from 3 randomly selected strains.

The investigators concluded that intraoperative contamination from ice water apparently caused the infections. This appears to be the first systematic epidemiologic investigation of an infection cluster following LASIK and the first to link *M. szulgai* infection with an environmental source. Contaminated ice water from lavage syringes may be a significant source of postoperative ophthalmic infection. Ice water is often contaminated and should not be used in association with surgical procedures.

FROM: Holmes GP, Bond GB, Fader R, Fulcher SF. A chilling experience: a cluster of *Mycobacterium szulgai* keratitis following laser-assisted in situ keratomileusis. Presented at the 41st Annual Interscience Conference on Antimicrobial Agents and Chemotherapy; December 16–19, 2001; Chicago, Illinois. Abstract no. K-478.

Gram-Negative Bacteria Among Peritoneal Dialysis Patients

Nasal and pericatheter colonization by *Staphylococcus aureus* presents an increased risk of peritonitis and exit-site infection for peritoneal dialysis (PD) patients. Perez-Fontan and colleagues from Hospital Juan Canalejo, A Coruna, Spain, conducted a study to examine the inci-

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dence of colonization by other peritoneal pathogens, and more specifically by gram-negative bacteria (GNB), among PD patients, and to disclose its potential correlation with PD-related infections. During a 3-year period, they prospectively screened 152 PD patients and 99 partners every other month for nasal and pericatheter bacterial colonization (total follow-up for patients, 3,182 months). They performed 1,089 sample assays in patients and 561 in partners.

Although *S. aureus* and coagulase-negative *Staphylococcus* species predominated in both patients and partners, the authors recovered GNB from 15.8% (nares) and 22.4% (pericatheter) of the patients and from 29.3% of the partners. Most isolations of GNB were transient and only 7.2% of the patients and 7.1% of the partners had the same GNB isolated in at least 2 controls from the same sampling. Older age, male gender, longer follow-up on PD, previous immunosuppressive therapy, low socioeconomic status, and a high global incidence of peritonitis were predictive of colonization by GNB.

Previous pericatheter mupirocin therapy was also associated with later colonization by GNB. Nasal or pericatheter colonization by bacteria other than *S. aureus,* particularly GNB, had a poor predictive power for PD-related infections.

The authors concluded that nasal and pericatheter bacterial colonization is variable in PD patients and their partners, and includes the significant presence of potentially pathogenic GNB. Colonization by GNB was not clearly associated with an increased risk of peritonitis or exit-site infection in these patients.

FROM: Perez-Fontan M, Rodriguez-Carmona A, Rosales M, Garcia-Falcon T, Valdes F. Incidence and clinical significance of nasal and pericatheter colonization by Gram-negative bacteria among patients undergoing chronic peritoneal dialysis. *Nephrol Dial Transplant* 2002;17:118-122.

Nosocomial Pathogen: *Moraxella catarrhalis*

Verduin and colleagues from The Netherlands point out that *Moraxella catarrhalis* (formerly known as *Branhamella catarrhalis*) has emerged as a significant bacterial pathogen of humans during the past 2 decades. Microbiological and molecular diagnostic techniques have been developed and improved for *M. catarrhalis*, allowing the adequate determination and taxonomic positioning of this pathogen. Also, studies have revealed its involvement in respiratory (eg, sinusitis, otitis media, bronchitis, and pneumonia) and ocular infections in children and in laryngitis, bronchitis, and pneumonia in adults. The development of (molecular) epidemiologic tools has enabled the national and international distribution of *M. catarrhalis* strains to be established, and has allowed the monitoring of nosocomial infections and the dynamics of carriage. Indeed, such monitoring has revealed an increasing number of ß-lactamase–positive *M. catarrhalis* isolates (now well above 90%), underscoring the pathogenic potential of this organism.

Although several putative *M. catarrhalis* virulence factors have been identified and described in detail, their relationship to actual bacterial adhesion, invasion, and complement resistance (and, ultimately, their role in infection and immunity) has been established in only a few cases. In the past 10 years, various animal models for the study of *M. catarrhalis* pathogenicity have been described, but not all of them are suitable for the study of human infection. Techniques involving the molecular manipulation of *M. catarrhalis* genes and antigens are also advancing our knowledge of the host response to and pathogenesis of this bacterial specie in humans, as well as providing insights into possible vaccine candidates. This review aims to outline our current knowledge of *M. catarrhalis*, an organism that has evolved from an emerging to a well-established human pathogen.

FROM: Verduin CM, Hol C, Fleer A, van Dijk H, van Belkum A. *Moraxella catarrhalis:* from emerging to established pathogen. *Clin Microbiol Rev* 2002;15:125-144.

Antimicrobial Formulary Change and Hospital Resistance Patterns

Empey and colleagues from the University of Kentucky Chandler Medical Center, Lexington, Kentucky, evaluated a university hospital formulary change that was designed to reduce the use of the third-generation cephalosporins ceftazidime and cefotaxime and replace them with the so-called "fourth-generation" cephalosporin cefepime. A retrospective review of antibiotic use and antimicrobial resistance was performed during two 6-month periods before and after the formulary change. All hospitalized patients with vancomycin-resistant *Enterococcus* (VRE), ceftazidime-resistant *Klebsiella pneumoniae* (CRKP), methicillin-resistant *Staphylococcus aureus* (MRSA), piperacillin-resistant *Pseudomonas aeruginosa* (PRPA), and ceftazidime-resistant *P. aeruginosa* (CRPA) infections were included in the study.

Ceftazidime use decreased from 9,600 to 99 g, and cefotaxime use decreased from 6,314 to 732 g, which represented a combined decrease of 89%. Use of cefepime increased from 0 to 5,396 g. Infections from CRKP decreased from 13% to 3%, PRPA infections decreased from 22% to 14%, and CRPA infections decreased from 25% to 15% ($P < .05$ for all). Infections from MRSA dropped insignificantly, and VRE infections increased significantly.

Substituting cefepime for ceftazidime and cefotaxime while reducing the overall use of cephalosporins appears to decrease the rates of CRKP, PRPA, and CRPA.

FROM: Empey KM, Rapp RP, Evans ME. The effect of an antimicrobial formulary change on hospital resistance patterns. *Pharmacotherapy* 2002;22:81-87.

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