

## Epidemic Outbreak of *Serratia marcescens* Infection in a Cardiac Surgery Unit

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Between 2 February and 16 April 1985, an outbreak of *Serratia marcescens* infection involving 10 male patients occurred in a cardiac surgery unit. All the patients had surgical wound infection, five also had osteomyelitis (four sternal, one costal), and another had peritonitis secondary to peritoneal dialysis. Three patients had concomitant bacteremia. All *Serratia* strains isolated produced a cherry-red pigment, and all had the same biochemical and antibiotic susceptibility pattern. An intensive search for the origin of the outbreak was initially unsuccessful, and it proved impossible to isolate *S. marcescens* from cultures of numerous samples taken from hospital personnel and from the environment. The fact that all patients were male and had been shaved for surgery by the same team of barbers led us to investigate the shaving procedures. We finally isolated a strain of pigmented *S. marcescens*, corresponding to that involved in the outbreak, from samples taken from the hands and equipment of the barbers. After suitable action had been taken, the epidemic terminated.

Nosocomial infections are a frequent cause of morbidity and mortality, especially in patients subjected to invasive techniques for either diagnostic or therapeutic reasons. These infections acquire particular relevance when they present with epidemic characteristics, and it is essential to trace the source of the infection to take necessary measures for its control (5, 10, 12, 20, 26).

*Serratia marcescens* is a well-known pathogen that is responsible for endemic and epidemic nosocomial infections and is associated with a high morbidity and mortality rate (3, 6, 9, 20, 28). Outbreaks of *S. marcescens* infection are particularly serious owing to the tendency of these microorganisms to infect severely compromised patients as a result of their resistance to antibiotics. The sources and transmission mechanisms of these outbreaks are variable and frequently remain undiscovered (1, 4, 7, 11, 15-19, 21-23, 25, 27).

We report an epidemic outbreak of infections caused by a pigmented strain of *S. marcescens* that occurred in the Intensive Care Unit of Cardiovascular Surgery (ICUCS) in our hospital. A very unusual source and mechanism of transmission were finally discovered.

### MATERIALS AND METHODS

We defined an epidemic outbreak as an abnormally high incidence of infections, i.e., one which surpasses, by at least 2 standard deviations, the previous average rate.

*S. marcescens* strains were identified by standard methods (Analytab API 20E), and antibiotic susceptibility was determined by agar dilution and Kirby-Bauer diffusion techniques (3, 24).

The epidemiological study consisted of interviews with nurses and sanitary personnel, a review of the most common procedures (hand washing, bladder catheterization, intravenous catheter care, etc.), and cultures of multiple samples from hospital personnel, patients, and the environment, including pressure transducers, tap water, soap, therapeutic solutions, antiseptics, respirators, and various other

sources. We took 91 samples from the hands of personnel, 6 samples of antiseptic solutions, 2 samples of intravenous solutions, 3 samples of tap water, 14 samples from pressure transducers, 17 samples from respirators, and 47 other samples (total, 180 samples). The charts of all patients involved in the outbreak were reviewed for clinical and epidemiological data.

### RESULTS

Our hospital is a 2,400-bed general and referral hospital with a very active cardiology and cardiac surgery service. The cardiac surgery unit has a special intensive care unit (ICUCS), which is exclusively devoted to its own patients.

Figure 1 shows the number of *S. marcescens* isolates and the number of patients with infection caused by *S. marcescens* as measured from October 1984 to August 1985 in the ICUCS, emphasizing the difference between the outbreak period and the preceding and following months.

Between 2 February and 16 April 1985, 10 patients admitted to the ICUCS had severe infections caused by a pigmented strain of *S. marcescens*. During this period, cases of infection with pigmented strains of *S. marcescens* occurred only in the ICUCS. All 10 patients involved in the outbreak were males; their ages ranged between 30 and 74 years. Eight had undergone open-heart surgery, and the remaining two had undergone aortic surgery (aortic coarctation, dissecting aneurism). All patients had surgical wound infections. Five also had osteomyelitis (four sternal, one costal), and one had peritonitis secondary to peritoneal dialysis. Three patients had concomitant bacteremia.

All patients received antimicrobial treatment, and seven required surgical cleaning and drainage of the wounds. One also required sternal fixation. One patient died after 13 days of hospitalization for hemodynamic reasons. After 1 year of follow-up, the remaining nine patients are alive and have no symptoms of infection.

The initial search for the origin of the outbreak, including interviews with hospital personnel, a review of the most common procedures, and the use of multiple samples for culture (see Materials and Methods), was unsuccessful and failed to isolate *S. marcescens*.

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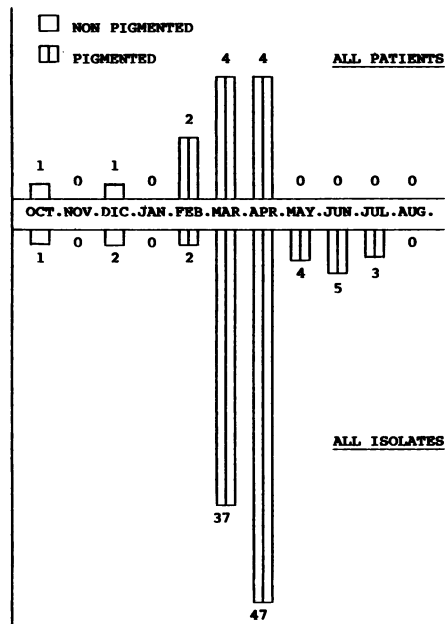


FIG. 1. *S. marcescens* isolates and infected patients in the ICUCS during the study period.

The fact that all patients were male and had been shaved for surgery on the previous day by the same team of barbers (at our hospital, females are shaved by the nursing staff, and males are shaved by a team of barbers employed by the hospital) led us to investigate the hands and equipment of the barbers and the procedures they used. The equipment used was in a lamentable state of hygiene, and we discovered that reusable brushes and blades were being used. Pigmented strains of *S. marcescens* with the same biotype and antibiogram as those isolated from the patients during the outbreak were isolated from the hands and equipment of the barbers. After suitable action (delegation of shaving of males to nursing staff and implementation of the obligatory use of disposable shaving equipment) had been taken, the epidemic terminated.

All microorganisms presented the same biochemical pattern in API 20E (identification code 5307761) and the same antibiotic susceptibility pattern in the diffusion and agar dilution tests (Table 1). All isolated strains produced a cherry-red pigment.

TABLE 1. Susceptibility pattern of all pigmented *S. marcescens* isolates

Antibiotic	MIC (µg/ml)	Susceptibility category <sup>a</sup>
Ampicillin	≥16	R
Ticarcillin	64	MS
Cefazolin	≥16	R
Cefoxitin	16	MS
Cefotaxime	≤8	S
Ceftazidime	≤8	S
Gentamicin	≤2	S
Tobramycin	≤2	S
Amikacin	≤4	S
Trimethoprim-sulfamethoxazole	≤1/20	S

<sup>a</sup> R, Resistant; MS, moderately susceptible; S, susceptible.

DISCUSSION

The importance of nosocomial infections to factors such as morbidity, mortality, and cost is indisputable, and their gravity is even greater when they involve seriously compromised patients and have an epidemic character (5, 6, 26).

Epidemic outbreaks of nosocomial infections caused by *S. marcescens*, particularly in intensive care and neonatology units, are well reported in the literature (1, 4, 7, 11, 15, 17-19, 21, 22, 25, 27). The morbidity and mortality caused by these infections are often due to the severity of the underlying diseases of the involved patients and to the resistance of many *Serratia* strains to antimicrobial agents (8, 14, 16, 19, 20, 23).

Sources of infection and mechanisms of transmission are diverse and include contaminated intravenous solutions (13), scalp vein needles (22), fiber-optic bronchoscopes (25), pressure transducers (7), bottles of aerosol inhalation therapy solutions (18), surgical hand-washing brushes (1), ultrasonic nebulizers (17), and peritoneal or bladder catheters (16, 28). On occasion, sources and mechanisms of transmission are not discovered (4, 15, 19, 21).

Our outbreak was caused by a strain that produces cherry-red pigment and that is seldom isolated nowadays. We were able to find only one other epidemic outbreak caused by a pigmented strain (25). The benign nature of the antimicrobial susceptibility pattern of the isolates causing the outbreak in our hospital and the adequacy and promptness of medical and surgical therapy might explain the high survival figures of our patients. Finally, the source of the outbreak, contaminated shaving brushes, has been reported in only two previous epidemic outbreaks of nosocomial infection, one caused by *S. marcescens* (27) and the other associated with *Pseudomonas aeruginosa* (2).

Barbers and their equipment and techniques should be routinely included in the search for the sources of postsurgical outbreaks of nosocomial infection.

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