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Single-Source Outbreak of *Candida tropicalis* Complicating Coronary Bypass Surgery

HENRY D. ISENBERG,[1]* VICTOR TUCCI,[1] FRANK CINTRON,[1] CAROL SINGER,[2] GERALD S. WEINSTEIN,[3] AND DENIS H. TYRAS[3]

Division of Microbiology,[1] Department of Medicine,[2] and Division of Cardiothoracic Surgery,[3] The Long Island Jewish Medical Center, The Long Island Campus for Albert Einstein College of Medicine, New Hyde Park, New York 11042-1433

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***Candida tropicalis* was isolated from the sternal wounds of eight coronary bypass patients from 18 to 89 days postoperatively; infections were limited to soft tissue in five patients but involved the sternum in three patients. Analysis of surgery records implicated one individual as the potential source of the yeast; this was confirmed by microbiological studies of fingertips and nasopharynx cultures of all personnel in contact with these patients. Only the suspect nurse, then acting as a scrub nurse and not as a circulator, infected the eight patients. Her removal from the cardiac team terminated the cluster outbreak.**

Infections of sternotomies are potentially grave complications of cardiac surgery. Infections of clean cases such as coronary bypass surgery wounds are usually caused by exogenous microorganisms, especially staphylococci (9). However, endogenous microbiota, especially from the skin, may be the etiological agents, albeit less frequently. Exogenous microorganisms are transmitted by the airborne route, a common vehicle, contacts, or vectors (17). Fungi, especially *Candida* spp., representing both sources have been isolated in small but steadily increasing numbers from hospitalized patients. Although relatively uncommon, yeast infections of postoperative wounds may be associated with significant morbidity. We describe a common-source cluster epidemic with *Candida tropicalis* involving cardiac bypass surgery wounds.

MATERIALS AND METHODS

Isolation from clinical specimens. Initially, yeasts were recovered from Sabouraud glucose agar (SGA; BBL Microbiology Systems, Cockeysville, Md.) and 5% sheep blood agar (BBL). After the first three cases, direct inoculation of SGA and Sabouraud glucose broth (SGB; BBL) to which vancomycin and tobramycin, both at 50 μg/ml, were added was carried out during the examination or debridement of the patient. A smear for Gram staining was procured at the same time. Broth showing turbidity within 6 days was subcultured to SGA and blood agar.

Surveillance cultures. (i) Personnel. Personnel were surveyed by lightly touching the tip of each finger to a numbered SGA plate; the plates were numbered to avoid identification of the individual by the analyst. Nose and throat specimens were obtained with cotton-tip applicators and placed into numbered vessels containing SGB plus antibiotic. The cultures were obtained by merely touching the nasopharyngeal membranes with the applicator.

(ii) Environment. Samples were taken from inanimate objects by streaking cotton-tip applicators, moistened with antibiotic-containing SGB, over an area of approximately 2.5 cm^2. When sinks were tested, the moistening of the applicator was omitted. Solutions were cultured by adding 0.5 ml to antibiotic-containing SGB. The Vitek yeast biochemical card (Vitek Systems, Inc., Hazelwood, Mo.) and API 20C (Analytab Products, Plainview, N.Y.) were both used to identify all yeast isolates. Each approach was quality controlled as advocated by the manufacturer. Both systems were used to ensure accuracy in identification, since both use assimilation reactions exclusively.

Patients. Eight patients who underwent coronary bypass surgery performed by three different surgeons developed sternal-wound infections with *C. tropicalis*. Pertinent details of their hospitalization and complications are summarized in Table 1. Cultures and smears of all wounds were examined for bacteria and fungi by appropriate methods advocated in the *Manual of Clinical Microbiology* (6). Blood cultures were drawn from the majority of patients in Isolator tubes (Du Pont Co., Wilmington, Del.) and cultured as described previously (5).

Personnel and environmental surveillance. All personnel involved with cardiac surgery were tested. They included seven nurses, six perfusionists, two surgical residents, two physician's assistants, three anesthesiologists, three anesthesia residents, three cardiothoracic surgeons, and two laboratory technologists.

The following items were surveyed in the two operating rooms (OR) dedicated to cardiothoracic surgery: OR table, anesthesia machine and attachments, overhead lamp bar, walls, intravenous pole, armboard, roller, cabinet shelves, door, and blood pressure cuff. The drains of four scrub sinks serving these OR, chlorhexidine gluconate (Hibiclens), and bar soap were also examined. One stroke (approximately 3.0 ml) of the chlorhexidine gluconate solution was placed in 5 ml of broth, and a moistened swab was used to sample the bar soap.

The two heart surgery unit rooms on the patient floor in which the involved patients resided during their initial hospitalizations were surveyed. The following items were tested: sink, walls, window sill, blood pressure cuff, and overbed table. The hydrogen peroxide solutions (12 bottles) used in this area to clean wounds routinely were also examined.

Record review. An epidemiological analysis of OR records and charts pertaining to the cluster was performed, with emphasis on the participation of personnel in the surgical procedures of the infected patients and any untoward incidents recorded during each procedure.

* Corresponding author.

TABLE 1. Patient demographics

Patient	Sex[a]	Surgical procedure[b]	Date of procedure (mo/day/yr)	Surgeon	Date infection noted (mo/day/yr)[c]	Site of infection	Date culture positive (mo/day/yr)
1	F	CAB×2	12/7/1988	A	12/21/1988	Sternum	12/22/1988
2	M	CAB×2	11/30/1988	B	1/15/1989	Sternum	1/16/1989
3	M	CAB×3	12/13/1988	B	1/26/1989	Superficial	1/27/1989
4[d]	M	CAB×2	1/23/1989	B	2/3/1989	Superficial	2/4/1989
5	M	CAB×3	12/28/1988	C	2/15/1989	Superficial	2/17/1989
6[e]	M	CAB×3	1/30/1989	C	2/17/1989	Superficial	2/18/1989
7	M	CAB×3	12/9/1988	C	3/8/1989	Superficial	3/9/1989
8	F	CAB×4	12/15/1988	B	3/10/1989	Sternum	3/11/1989

[a] F, Female; M, male.
[b] CAB, Coronary artery bypass; ×2, double bypass; ×3, triple bypass; ×4, quadruple bypass.
[c] All patients were discharged within 10 days of the procedure and required readmission, except patient 1, who developed the complication during initial hospitalization.
[d] *E. faecalis* was isolated as a companion organism.
[e] *S. aureus* was isolated as a companion organism.

RESULTS

The isolation of *C. tropicalis* from three coronary artery bypass sternotomy wounds within approximately 5 weeks of each other indicated a potential problem, because *C. tropicalis* had not been involved in any surgical infections in this institution since 1980. Rare fungemia caused by this yeast had been found in medical oncology patients and premature infants during that time. The appearance of the fourth coronary artery bypass infection led to an investigation in an attempt to detect a common source for the outbreak. Examination of all records in the OR and heart surgery unit narrowed suspicion to personnel and the hydrogen peroxide used for wound care. The only individual involved in the surgeries of all infected patients was a scrub nurse, referred to below as the suspect nurse. This nurse had been trained in the special requirements of cardiac surgery since 17 October 1988; she acted as a circulating nurse until 10 November 1988 and then assisted at the level of a scrub nurse. She participated in a total of 80 cardiac surgical procedures, performing the duties of a scrub nurse on 28 coronary artery bypass operations. She did not participate in any procedures involving valve replacement.

To avoid bias, personnel were sampled randomly in the OR as described above. After 24 h of incubation, only the fingertip cultures of the suspect nurse showed numerous yeast colonies. None of the cultures from the remaining 27 OR subjects tested in the identical fashion yielded yeast colonies after 8 days of incubation. The broth cultures of the nose and throat specimens of the suspect nurse were turbid after overnight incubation. Subculture to SGA and sheep blood agar yielded yeasts. Yeasts were isolated from the nose and throat cultures of five other members of the team only after 6 days of incubation of the broth. These were identified as *C. albicans* in four cultures and *Torulopsis glabrata* in one culture. The fingertip and nasopharyngeal cultures of the suspect nurse yielded two yeasts; one was identified as *C. tropicalis*, and the other was identified as *T. glabrata*.

Since none of the environmental specimens or the samples from the colleagues of the suspect nurse yielded *C. tropicalis*, this individual was excused from participating in nursing responsibilities. It is of interest that transmission of *C. tropicalis* occurred only while the suspect nurse worked as a scrub nurse and not as a circulating nurse. After the initial period as a circulator, she performed this chore interspersed with responsibilities as a scrub nurse during the time that the patients were infected.

The yeast infections were limited to soft tissue in five of the patients and involved the sternum in the other three. Although patient 1 developed the sternal infection prior to discharge and within 14 days of the surgical procedure, the infection took 18 to 89 days to become overt in the other patients. Gram-stained smears of all sternum sites revealed yeasts, whereas *Enterococcus faecalis*, isolated from one patient, was not discerned on the smear. On a Gram stain performed on another patient, gram-positive cocci, subsequently identified as *Staphylococcus aureus*, were more prevalent than the yeasts. Two patients, patients 1 and 6, had diabetes mellitus, whereas patient 2 had chronic obstructive pulmonary disease.

DISCUSSION

Nosocomial candidiasis is reported to be on the increase (17), particularly in patients with underlying malignancies. Neutropenia, antibiotic and steroid therapies, hyperalimentation, burns, various venous access devices, intra-abdominal surgery, and intravenous drug abuse also predispose individuals to candidal infections. An environmental reservoir for those *Candida* species involved in nosocomial infections has not been established (3, 13). The older literature (1, 10) indicates that the yeasts are not transmitted through droplets or by the airborne route. However, rare cluster epidemics have been noted; these were caused by fomites (4, 7), contaminated irrigation solutions and hyperalimentation preparations involving a contaminated pumping system (12, 14, 15), inadequate sterilization of pressure-monitoring devices (15, 18), and endophthalmitis subsequent to the use of irrigating solutions (8, 16). Cross-infection in adult and pediatric intensive care units has been reported (3, 13), leading to the conclusion that hand carriage by hospital personnel may play a very important role in the transmission of these organisms (2). The yeasts involved in these exogenous transmissions and outbreaks were predominantly *C. albicans* and less commonly *C. parapsilosis*. The role of hands in the transmission of fungi in such outbreaks must be tempered by the observation that in a normal human population, *Candida* spp. are recovered from the skin in fewer than 1% of the individuals examined (11). This is in contrast to the recovery of *Candida* spp. from the oral cavity (10%), stool (15%), and vagina (10%) of normal individuals. The *C. tropicalis* infections displayed a spectrum of host responses including erythema, purulent drainage, bland dehiscence, and fluid collection behind the sternum. The majority of the patients required surgical debridement.

Unfortunately, the suspect nurse resigned her position and was not available for a thorough physical examination that could explain her excessive carriage of *C. tropicalis*. Her supervisors did not observe breaks in technique during procedures but noted that she could not use the usual scrub solutions and substituted hypoallergenic soap. When tested, this bar soap did not yield *C. tropicalis*, but it did not contain fungicides. Some of the colleagues of the suspect nurse indicated that she may have had onychomycosis covered with a thick layer of nail polish, which did not prevent carriage of the yeast on her fingertips and in her nasopharynx. The manner in which the sternal incisions of the eight patients were infected with *C. tropicalis* cannot be explained. One might propose that a very large number of yeast cells on her hands may have provided an inoculum through pinholes in her gloves. The efficiency of the face mask declines with time; the coronary artery bypass procedures may be sufficiently long to provide the opportunity to disseminate oropharyngeal *Candida*, especially when this anatomic site is heavy colonized. This may indeed apply to this individual, since her nose and throat cultures reached approximately McFarland 2 densities within 18 h. Close contact with the operative field appears to have been required for the transmission of the yeast from the suspect nurse to the patients, since the nurse performed as a circulating nurse in 52 instances and none of these patients became infected. Of the 28 coronary artery bypasses in which she assisted as a scrub nurse, 8 have resulted in infections to date, an attack rate of almost 30%. Since *Candida* endocarditis post-cardiac surgery may take years to manifest (9), additional cases may still appear in the future.

C. tropicalis nosocomial complications of cardiac surgery have not been reported before. The paucity of information on the health of the suspect nurse does not permit a complete analysis of the mode of transmission. She was the only individual who participated in all infected cases. The only other common vehicle could have been the hydrogen peroxide, which was routinely used in wound care postoperatively. No yeasts were recovered from the 12 bottles in use in the heart surgery unit. Although the majority of nosocomial infections due to *C. tropicalis* arise from endogenous colonization, this cluster epidemic must be ascribed to a common source, in this instance the hands and oropharynx of the scrub nurse.

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