

# Recovery of Anaerobic Bacteria From Four Children With Postthoracotomy Sternal Wound Infection

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**ABSTRACT.** The cases of 4 children who developed postthoracotomy sternal wound infection caused by anaerobic bacteria are presented. The predominate anaerobes were *Peptostreptococcus* species and pigmented *Prevotella* species. Polymicrobial infection was present in all cases, and aerobic bacteria also were recovered in 2 instances. All patients responded to surgical debridement and antimicrobials effective against the isolated aerobic and anaerobic bacteria. These findings highlight the potential importance of anaerobic bacteria in postthoracotomy sternal wound infection. *Pediatrics* 2001; 108(1). URL: <http://www.pediatrics.org/cgi/content/full/108/1/e17>; anaerobic bacteria, *Peptostreptococcus* species, *Prevotella* species, *Staphylococcus aureus*, sternal wound.

ABBREVIATION. PTSWI, postthoracotomy sternal wound infection.

Postthoracotomy sternal wound infection (PTSWI) is a major complication after cardiac surgery in adults<sup>1-3</sup> and children.<sup>4-8</sup> The organisms that are recognized as causing most of these infections in adults and children are mostly *Staphylococcus aureus*, *Staphylococcus epidermidis*, and members of the family Enterobacteriaceae, such as *Escherichia coli*, *Klebsiella* species, *Enterobacter* species, and *Proteus* species.<sup>4,9,10</sup> Although anaerobic bacteria were described in PTSWI in adults,<sup>11</sup> their recovery has not been documented previously in children. This report describes 4 patients who developed PTSWI caused by anaerobic bacteria.

## METHODS

The patients described were treated and studied by the author for PTSWI in hospitals in the metropolitan Washington, DC, area between 1983 and 1998 and did not include all of the patients who had PTSWI during this period. The hospitals included the Hospital for Sick Children and Georgetown University Hospital in Washington, DC. The total number of patients who had had a sternal thoracotomy procedure performed on them at these institutions during these years was not recorded. Included were only patients who had developed PTSWI caused by anaerobic bacteria. Patients' medical and laboratory data were reviewed.

Antimicrobial agents were given as surgical prophylaxis to all patients and included a first-generation cephalosporin (patients 1-3; Table 1) and penicillin (patient 4).

Specimens were obtained by direct needle aspiration of the

purulent contents into a syringe that was immediately sealed and transported to the laboratory within 30 minutes or by swab that was dipped into the pus and introduced into an anaerobic transport system (Port-A-Cul; BBL Microbiology Systems, Cockeysville, MD) or a Vacutainer (BD Vacutainer System, Rutherford, NJ) and transported to the laboratory within 2 hours.

Sheep's blood (5%), chocolate, and MacConkey agar plates were inoculated at 37°C aerobically (MacConkey) or under 5% CO<sub>2</sub> (blood and chocolate) and examined at 24 and 48 hours. For isolation of anaerobes, the specimen material was plated onto prereduced vitamin K<sub>1</sub>-enriched Brucella blood agar, an anaerobic blood agar plate containing kanamycin and vancomycin, and an aerobic blood plate containing colistin and nalidixic acid and inoculated into an enriched thioglycolate broth,<sup>12</sup> incubated in GasPak jars (BBL Microbiology Systems), and examined at 48 and 96 hours. Plates that showed growth were held until the organisms were processed and identified. All cultures that showed no growth were held for at least 5 days. Anaerobic and aerobic bacteria were identified as described previously.<sup>12,13</sup>

## RESULTS

Polymicrobial infection was present in all instances. The number of isolates varied from 2 to 3. The predominant anaerobes were *Peptostreptococcus* species (3) and pigmented *Prevotella* (2). Anaerobic bacteria only were recovered in 2 patients (patients 1 and 4; Table 1), and mixed aerobic and anaerobic bacteria were isolated in the 2 others (patients 2 and 3).

A median sternotomy incision was performed for repair of congenital defects in all cases. The infections were diagnosed between 18 to 31 days after surgery. All patients had factors that have been shown to predispose to infection.<sup>4,7</sup> These included a perfusion time in excess of 1 hour, prolonged ventilation time (>200 hours), delayed sternal closure (>1 day), and inappropriate antimicrobial prophylaxis.

Signs and symptoms associated with PTSWI included fever (38°C-40°C; in all patients), erythema or cellulitis (in all patients), purulent (3 patients) or sanguinous (1 patient) wound discharge, foul-smelling discharge (3 patients), and instability of the sternum (2 patients). A leukocytosis of 16 600/mm<sup>3</sup> to 23 800/mm<sup>3</sup> with neutrophil predominance (64%-80%) was present when the diagnosis of PTSWI was made in all cases.

Therapy for the PTSWI included open (3 cases) or local (1 case) debridement and parenteral and oral antimicrobial therapy for 28 to 44 days. All patients recovered without complications.

## DISCUSSION

This report describes for the first time the isolation of anaerobic bacteria from PTSWI in children. These organisms were recovered as the sole isolates in 2

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**TABLE 1.** Clinical Features of Median Sternotomy Wound Infections in Children

Patient Number	Age	Gender	Diagnosis	Surgical Repair	Interval From Surgery to Diagnosis	Predisposing Factor(s)	Isolate (Source)	Antimicrobial Duration of Antibiotic Therapy	Surgical Procedure	Outcome
1	7 y	F	Wound infection	Ventricular septal defect	23 d	Prolonged perfusion time	<i>Prevotella intermedia</i> , <i>Peptostreptococcus micros</i> (wound)	Imipenem (IV) 14 d amoxicillin-clavulanate (PO) 14 d	Open debridement	Healed
2	3 y	F	Wound infection, bacteremia	Ventricular septal defect	18 d	Prolonged ventilation time, delayed closure	<i>Staphylococcus aureus</i> (blood, wound), <i>Bacteroides thetaiotaomicron</i> (wound), <i>Peptostreptococcus prevotii</i> (wound)	Clindamycin (IV, PO) 20 d, vancomycin (IV) 15 d	Open debridement	Healed
3	5 y	F	Wound infection	Fallop's tetralogy	28 d	Prolonged ventilation and perfusion time	<i>Escherichia coli</i> (blood, wound), <i>Clostridium perfringens</i> (wound)	Clindamycin (IV, PO) 30 d, gentamicin (IM) 14 d	Open debridement	Healed
4	24 mo	M	Wound infection, bacteremia	Transposition of the great vessel	31 d	Inadequate antimicrobial prophylaxis, re-exploration for bleeding, prolonged ventilation time	<i>Prevotella melanogenica</i> (blood, wound), <i>Peptostreptococcus</i> species (wound), <i>Propionibacterium acnes</i>	Ticarcillin-clavulanate 10 d, amoxicillin-clavulanate (PO) 16 d	Local debridement	Healed

IV indicates intravenously; PO, orally.

instances and mixed with aerobic bacteria in 2 instances. The isolation of these endogenous organisms from these infections may be attributable to their inoculation from the patient's normal flora. *Peptostreptococcus* and *Prevotella* species are part of the oropharyngeal flora<sup>14</sup> and have been recovered previously from breast abscesses<sup>15</sup> and head and neck abscesses.<sup>16</sup> Similarly, *Bacteroides fragilis* group and *E coli* are part of the gastrointestinal flora<sup>14</sup> and have been recovered previously from umbilical infections in newborns<sup>17</sup> and from skin and soft-tissue infection in children.<sup>18</sup>

These findings are similar to our previous data collected from adults.<sup>11</sup> Specimens from 65 adult patients with PTSWI were studied for aerobic and anaerobic bacteria. Aerobic or facultative bacteria only were recovered in 50 specimens (77%); anaerobic bacteria only in 6 (9%); and mixed aerobic, facultative, and anaerobic bacteria in 9 (14%). The predominant aerobes were *S epidermidis* (28 isolates), *S aureus* (21 isolates), and members of the family Enterobacteriaceae (14 isolates). The predominant anaerobes were *Peptostreptococcus* species (10 isolates), *Bacteroides* species (4), and *Clostridium* species (3).

Part of the reason that anaerobic bacteria were not reported previously in children may be attributable to inadequate methods for transportation and cultivation of specimens in previous studies.<sup>4,7</sup> One of these studies reported observing Gram-negative rods in Gram-stain preparation of sternal drainage without obtaining any bacterial growth.<sup>4</sup>

Management of PTSWI includes surgical debridement and administration of systemic antimicrobials. Many of the antimicrobials that are effective against *S aureus* and Enterobacteriaceae are not effective against all anaerobic bacteria. Anaerobic Gram-negative bacilli isolated from clinical infections can be resistant to penicillins through the production of  $\beta$ -lactamase.<sup>16</sup> The presence of penicillin-resistant anaerobic organisms may require the use of agents that are effective against these bacteria. These antimicrobials include clindamycin, metronidazole, imipenem, cefoxitin, chloramphenicol, or the combination of a penicillin (eg, amoxicillin) and a  $\beta$ -lactamase inhibitor (eg, clavulanate).<sup>19</sup>

Prospective studies are warranted to elucidate the role of anaerobic bacteria in PTSWI in children. It is recommended, however, that specimens from those sites be cultured for both aerobic and anaerobic bacteria so that when systemic antimicrobials are used, coverage for these organisms can be appropriate.

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