Dermabacter hominis: a usually daptomycin-resistant gram-positive organism infrequently isolated from human clinical samples

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Abstract

During a 12-year period, Dermabacter hominis was isolated from 21 clinical samples belonging to 14 patients attending a tertiary hospital in León, Spain. Samples included blood cultures (14), peritoneal dialysis catheter exit sites (three), cutaneous abscesses (two), an infected vascular catheter (one) and a wound swab (one). Identification was made by API Coryne™ V2.0, Biolog™ GP2 and 16S rRNA gene amplification. Six febrile patients had positive blood cultures (one, two or three sets) and all of them were treated with teicoplanin (two patients), vancomycin, ampicillin plus gentamicin, amoxicillin/clavulanic acid and ciprofloxacin (one each). An additional patient with a single positive blood culture was not treated, the finding being considered non-significant. In the remaining seven patients the organism was isolated from a single specimen and three of them received antimicrobial treatment (ciprofloxacin, ceftriaxone plus vancomycin and amoxicillin/clavulanic acid). At least ten patients had several underlying diseases and conditions, and no direct mortality was observed in relation to the isolated organism. All isolates were susceptible to vancomycin, rifampin and linezolid. Resistance to other antibiotics varied: erythromycin (100%), clindamycin (78.5%), ciprofloxacin (21.4%) and gentamicin, quinupristin-dalfopristin, benzylpenicillin and imipenem 7.1% each. Thirteen isolates were highly resistant to daptomycin with MICs ranging from 8 to 48 (MIC90 = 32 mg/L); only one was daptomycin-sensitive (MIC = 0.19 mg/L).

Keywords: Antimicrobial susceptibility, clinical relevance, daptomycin resistance, Dermabacter hominis, identification, isolation

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Introduction

Dermabacter hominis, formerly known as coryneform bacteria of Centers for Disease Control groups 3 and 5, is a facultative anaerobic, catalase-positive, non-motile, glucose, maltose and sucrose fermentative, irregular gram-positive bacillus. It hydrolyses aesculin and decarboxylates ornithine and lysine, and grows on nutrient and blood agar forming white, convex, creamy or dry colonies of 1–1.5 mm diameter at 48 h in an aerobic atmosphere, resembling coagulase-negative staphylococci [1–3]. It can be identified by conventional phenotype-based methods, including the API Coryne™ V2.0, and matrix assisted laser desorption ionization-time of flight mass spectrometry system [2,4,5]. A confirmatory test such as 16S rRNA gene sequencing is also recommended [2,4].

Dermabacter hominis is considered a common colonizer from human skin [1]. Operational taxonomic units with 99% sequence identity to the 16S rDNA gene of D. hominis have been identified in skin samples in the course of the Human Microbiome Project [6,7] and in human gastrointestinal specimens [8]. Furthermore, D. hominis has been isolated from a variety of clinical specimens, such as blood cultures,
Dermabacter hominis is usually susceptible to vancomycin, teicoplanin and linezolid with variable susceptibility to benzylpenicillin, ampicillin, cephalosporins, ciprofloxacin, clindamycin, erythromycin, gentamicin, tobramycin, amikacin, chloramphenicol, fusidic acid and rifampin [2,11,13–16]. Daptomycin, a lipopeptide antibiotic, is usually very active against most gram-positive organisms including members of the Corynebacterium genus and most diphtheroids [4,17–19]. However, very little information exists on daptomycin activity against D. hominis although a couple of communications to congresses suggest that this organism could be daptomycin-resistant (Cercenado E, Marín M, Gama B, Alcalá L, Bouza Santiago E. Daptomycin-resistant Dermabacter hominis: an emerging Gram-positive coryneform rod causing human infections. 23rd European Congress of Clinical Microbiology and Infectious Diseases, abstract 0451; Fernández-Natal I, Sáez-Nieto JA, Valdezate-Ramos S, et al., Daptomycin-resistant coagulase-negative Staphylococcus? No, Dermabacter hominis. XVII Congress of the Spanish Society of Infectious Diseases and Clinical Microbiology, abstract 473).

The aims of this study are to review clinical and epidemiological characteristics of patients with D. hominis isolated from diverse clinical samples. In addition, antimicrobial susceptibility to a variety of antimicrobials has been determined with special attention to daptomycin activity.

## Material and Methods

### Clinical samples

Isolates were recovered from 14 blood cultures (BacT/Alert™, bioMérieux, Marcy-l’Etoile, France), three peritoneal dialysis catheter exit sites, two cutaneous abscesses, an infected vascular catheter and a wound swab. These samples were received in the clinical laboratory from January 2000 to December 2012 and belonged to 14 patients attending in a tertiary hospital in León, Spain.

### Identification

Isolates were identified by using conventional phenotypic methods, API Coryne™ V2.0 (bioMérieux), and Biolog™ GP2 (Biolog, Inc., Hayward, CA, USA). In addition, identification was confirmed by 16S rRNA gene sequencing using a previously reported method [20].

### Epidemiological and clinical data

Regarding age, sex, underlying diseases and conditions, antimicrobial treatment and outcome were retrospectively recorded by reviewing clinical charts.

### Antimicrobial susceptibility

Antimicrobial susceptibility was determined by the Etest® method on Mueller–Hinton sheep blood agar plates, incubated at 37°C in aerobicosis for 24–48 h. The following Etest strips (bioMérieux) were used: benzylpenicillin, ampicillin, cefotaxime, imipenem, gentamicin, ciprofloxacin, moxifloxacin, tetracycline, tigecycline, rifampin, chloramphenicol, cotrimoxazole, erythromycin, clarithromycin, azithromycin, clindamycin, quinupristin-dalfopristin, linezolid and vancomycin. Daptomycin susceptibility was determined by using a calcium-supplemented MIC Test Strip (Liofilchem® s.r.l., Roseto degli Abruzzi, Italy). The MICs of 11 antibiotics were categorized as susceptible, intermediate and resistant following the CLSI-M45-A-2012 document for coryneform organisms [21]. Resistance to daptomycin was defined as MICs >1 mg/L. Staphylococcus aureus ATCC 29213 and Enterococcus faecalis ATCC 29212 served as controls. Phenotypic resistance to macrolide–lincosamide–streptogramin B antibiotics (MLSb) was determined by a previously reported method [22].

## Results

One isolate from each patient was characterized. All isolates were identified by API Coryne™ V2.0 with good to very good scores (>99.7% ID) with the following profiles: 4570165 (n = 5), 4570765 (n = 5), 4570325 (n = 2) and 4570365 (n = 2). Biolog™ GP2 identified all isolates with 85–100% of profiles corresponding to the taxon. The results of 16S rRNA gene sequences (fragments between 1360 and 1455 bp) were compared with sequences available in databases using BLAST, and they showed a homology of 99.3–99.9% with D. hominis.

Table 1 presents the main epidemiological and clinical data regarding patients, source and antimicrobial treatment. The age of the patients ranged from newborn to 79 years (mean, 54.0 years) with a male/female rate of 10/4. Twelve cases were considered to be hospital-related or healthcare-related and only two were community-acquired. At least ten patients had several underlying diseases and conditions (chronic renal failure, peritoneal dialysis, haemodialysis, human immunodeficiency virus infection, chronic hepatitis, preterm rupture of the membranes, lymphoma, lung cancer, cytotoxic treatment and neutropenia). Seven bacteraemic patients were diagnosed after one (two patients), two (three patients) and three (two patients) positive blood cultures. Five of these patients were treated with antibiotics that were proved to be active in vitro against the isolate: teicoplanin (two patients); vancomycin, amoxicillin/clavulanic acid and ampicillin plus gentamicin one patient each. One patient received ciprofloxacin, later proven...
not to be active in vitro against the isolate and the remaining patient did not receive antibiotics.

In the seven remaining patients the organism was isolated in pure culture from a single clinical specimen. Exudates from cutaneous abscesses, vascular catheter and wound swab were Gram-stained and moderate numbers of polymorphonuclear leucocytes and coryneform organisms were seen. Three of the patients had positive peritoneal dialysis catheter exit site samples and one of them was treated with an antibiotic that was active in vitro against the isolate (ciprofloxacin), whereas the other two patients did not receive any antimicrobial treatment. One patient with a catheter infection and another one with a cutaneous abscess also received antibiotics active in vitro against the isolate (ceftriaxone plus vancomycin, and amoxicillin/clavulanic acid), the latter also requiring surgical drainage of the abscess. There was not enough clinical information regarding the other two patients. No mortality directly related with isolation of D. hominis was observed.

Table 2 presents the results of antimicrobial susceptibility of 14 D. hominis isolates to 21 antimicrobials. All isolates were susceptible to vancomycin, rifampin and linezolid. No resistance to tetracycline was detected although three isolates fell into the intermediate category. Eleven isolates were highly resistant to erythromycin and clindamycin (MICs > 256 mg/L), and only one of them was resistant to quinupristin-dalfopristin. Low-level resistance to erythromycin (MICs 1.5 – 2 mg/L) was detected in three isolates, which were all susceptible to clindamycin and quinupristin-dalfopristin. Resistance to other antibiotics varied: ciprofloxacin (21.4%); gentamicin, quinupristin-dalfopristin, benzylpenicillin and imipenem 7.1% each. Thirteen isolates were highly resistant to daptomycin with MICs ranging from 8 to 48 (MIC90 = 32 mg/L) whereas only one was daptomycin-sensitive (MIC = 0.19 mg/L).

Although there are no defined susceptibility breakpoints for many of the other tested antibiotics, the low MIC values obtained in all isolates for teicoplanin (<0.19 mg/L), tigecycline (<0.5 mg/L), and in 11 isolates for ampicillin, cefotaxime and moxifloxacin (<1 mg/L) should be noted. The results for clarithromycin and azithromycin were similar to those of erythromycin. Seven isolates had chloramphenicol MICs <1 mg/L. On the other hand 12 isolates presented MICs >32 mg/L for cotrimoxazole.

Discussion

Dermabacter hominis is the only recognized species of the Dermabacter genus and it can be easily identified by phenotypic conventional methods, including the API Coryne™ V2.0 system [2,4] and matrix-assisted laser desorption/ionization–time of flight mass spectrometry [5]. Our data, together with the published information [2,10–13], indicate that the predominant API Coryne™ profiles for D. hominis are 4570365, 4570765 and 4570165. Identification of D. hominis by using the Biolog™ system proved to be useful and reliable. As widely demonstrated for other organisms, including members of the Corynebacterium genus and coryneforms [2,4,20], the study of the 16S rRNA gene sequence confirmed phenotypic identification.

We have isolated D. hominis from a variety of clinical samples including 14 blood cultures belonging to seven patients. Among the seven bacteraemic patients, five were immunosuppressed and one had a lung infection secondary to bronchoaspiration, and all were treated with antibiotics. The remaining patient who had a single positive blood culture did not receive antimicrobial treatment because the culture was not considered clinically relevant.
The antimicrobial susceptibility of 14 *Dermabacter hominis* isolates (MICs in mg/L)

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In the seven remaining patients, the organism was isolated from a single clinical specimen. Three of these patients received antibiotics that were active in vitro against the isolate, plus surgical drainage in the case of a cutaneous abscess. Although the clinical information is not complete for all patients, the data obtained support that *D. hominis* can be an opportunistic microorganism usually associated with very low mortality, in agreement with what has been previously reported [2,3,9–12]. Nevertheless, a fatal septicemia in an immunosuppressed patient has been reported [13].

The antimicrobial susceptibility of *D. hominis* is variable but it has always been uniformly susceptible to vancomycin and linezolid [2,11,13–16], which is also confirmed in the present study. We have not found resistance to rifampin and tetracycline, and the rate of benzylpenicillin, imipenem, quinupristin-dalfopristin resistance was very low (7.1%). Moderate resistance was found for ciprofloxacin (21.4%). The high rate of erythromycin and clindamycin resistance as well as the results with quinupristin-dalfopristin suggests that resistance to MLSB antibiotics is mainly constitutive, probably due to the presence of the erm gene in 78.5% of our isolates.

The very recently established draft genome sequence of isolate no. 5 (our unpublished data) led to the detection of the corynebacterial *erm(X)* gene in this strain, explaining the resistance against antimicrobials of the MLS class [23]. The genome of isolate no. 5 also contains the *cmx* transporter gene for chloramphenicol resistance, the *strAB* tandem genes for streptomycin resistance [23] and the *sul* gene encoding a dihydropyrimidone synthase that can confer resistance to a broad spectrum of sulphonamides [24]. The gyrA gene contains the deduced sequence motif FAIYD in the quinolone-resistance-determining region, which might be associated with ciprofloxacin, moxifloxacin and levofloxacin resistance [25].

The high rate of daptomycin-resistance is remarkable and it contrasts with the wide and powerful activity of this drug against most gram-positive organisms, including *S. aureus*, enterococci, members of the *Corynebacterium* species and coryneforms [4,6–19]. Although daptomycin’s mechanism of action has not been fully elucidated, it seems to act by insertion into the bacterial cell membrane in a calcium-dependent manner, resulting in rapid membrane depolarization [26]. The addition of ionized calcium is highly recommended for in vitro testing of daptomycin, as the MICs are much lower when a concentration similar to that found in human serum is incorporated [17,18]. All except one of our *D. hominis* isolates presented high daptomycin MICs in spite of having been tested in calcium-supplemented conditions. This emphasizes the relevance of our findings. Our report confirms what had been communicated to congresses on daptomycin resistance in this organism but it also presents what we believe is the first report of a daptomycin-susceptible *D. hominis* strain.
Funding


Conflict of Interest

The authors declare no conflicts.

References


