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Diagnosis of venous access port colonization requires cultures from multiple sites: should guidelines be amended?☆,☆☆

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ABSTRACT

Data on microbiological management of withdrawn venous access ports (VAPs) are scarce. The aim of our study was to assess the validity of Gram stain and culture performed on VAPs to detect colonization and VAP-related bloodstream infection (VAP-RBSI). We prospectively performed cultures of the following: catheter tip (roll-plate and sonication), port content aspirate before and after sonication, port sonication fluid (PSF), and port internal surface biofilm (ISB). The gold standard of VAP colonization was positivity of at least 1 of the cultures mentioned above. We collected 223 VAPs in which no single culture had validity values reliable enough to predict colonization and VAP-RBSI. The best validity values were those obtained when cultures of catheter tip (roll-plate), PSF, and port ISB were combined. Cultures from several areas on the VAP are necessary to ensure suitable assessment of colonization and VAP-RBSI.

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1. Introduction

Venous access ports (VAPs) are widely used for long-term access to the vascular system, mainly in patients with prolonged illnesses. Patients with VAPs are at risk of infection, which, although uncommon, is a very serious cause of morbidity and mortality and frequently requires the catheter to be withdrawn (Biffi et al., 1998; Chang et al., 2003; Crisinel et al., 2009; Fernandez-Hidalgo et al., 2008; Groeger et al., 1993; Kuizon et al., 2001; Mauri et al., 2010; Rosenthal et al., 2006; Samaras et al., 2008; Wisplinghoff et al., 2003; Yildizeli et al., 2004). Catheter-related infection is confirmed by demonstration of colonization in parts of the VAP other than the tip, since tip culture alone does not frequently yield microorganisms in cases with demonstrated colonization (Mermel et al., 2009). The issue of which parts of the VAP should be analyzed to detect colonization remains unresolved, although current evidence points to the internal surface of the port reservoir (Douard et al., 1999; Longuet et al., 2001; Whitman and Boatman, 1995).

Our objectives were to evaluate the reliability of Gram stain and culture at different sites on the inside and outside of VAPs and to find the best combination of cultures for predicting VAP colonization and VAP-related bloodstream infection (VAP-RBSI).

2. Materials and methods

2.1. Setting

Ours was a prospective study performed between July 2009 and April 2011 at a large institution in Madrid, Spain.

We included all tunneled VAPs (Port-A-Caths) that were routinely removed at the Department of Vascular Interventional Radiology, irrespective of the reason for withdrawal. We also included those devices with suspicion of infection, which were removed in surgery departments or emergency rooms.

2.2. Laboratory procedures

When a VAP arrived at the microbiology laboratory, it was cut in 2 parts: the distal segment of the catheter tip and the port reservoir.

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2.2.1. Catheter tip procedure

Gram staining (first) and culture of the catheter tips were performed using the roll-plate technique and sonication method (in a random order 1:1).

Gram stain was performed by rolling the external surface of the distal catheter segment 3 times on a sterile glass slide with 2–3 drops (about 15 μL each) of sterile water on the surface. Slides were heat fixed and Gram stained following standard methods. The reading was taken at ×100 along 3 longitudinal lines over 5–7 minutes, and the presence of at least 1 microorganism on the reading surface was considered positive. All the slides were read before culture results were available (Bouza et al., 2006; Murray, 1985).

Maki's semi-quantitative roll-plate technique was performed by transferring each catheter tip to a plate with Columbia agar supplemented with 5% sheep blood and rolling the tip back and forth across the surface at least 3–4 times (Maki et al., 1977).

Sonication was performed by placing the catheter tip in 10 mL of brain-heart infusion broth, sonicating for 1 minute (35,000 Hz and 125 W), and vortexing for 15 seconds. Again, 0.1 mL of the sonicated broth and 0.1 mL of a 1:100 dilution of the broth were streaked onto sheep blood agar plates (Sherertz et al., 1990).

The plates were incubated aerobically for 48 hours at 37 °C. The number of colonies recovered was counted.

2.2.2. Port reservoir procedure

Gram staining and culture (Columbia blood agar) were performed on the following samples: port content aspirate before and after sonication, port sonication fluid (PSF), and port internal surface biofilm (ISB).

Gram staining was performed by adding 1 drop of sample from each site onto a sterile glass slide and proceeding as described above.

Port content aspirate before sonication (CABS) was obtained by aspirating all the liquid collected at the port with a 1-mL syringe. One drop (50 μL) of the liquid was cultured.

Next, the whole port was embedded in a sterile container with 20 mL of sterile phosphate-buffered saline (PBS), sonicated for 1 minute (35,000 Hz and 125 W), and vortexed for 15 seconds. Then, 100 μL of the PBS used for the port sonication was cultured (PSF).

Port content aspirate after sonication (CAAS) was obtained by instilling and aspirating saline with a 1-mL syringe. One drop (50 μL) of the liquid was also cultured.

Lastly, the port silicone membrane was opened using a punch, and a sterile swab was rubbed on the ISB for qualitative culture.

The plates were incubated aerobically for 48 hours at 37 °C. The number of colonies recovered was counted.

The microorganisms recovered from cultures were identified by standard microbiologic methods using the automated MicroScan system with the POS Combo Panel Type 2S and NEG Combo Panel Type 1S (DADE Behring, Sacramento, California, USA) for bacteria and the API ID 32C (bioMérieux, Marcy l'Etoile, France) for fungi.

2.3. Definitions

2.3.1. Pocket infection

Pocket infection is infected fluid in the subcutaneous pocket of a totally implanted intravascular device. This infection is often associated with tenderness, erythema, and/or induration over the pocket. Spontaneous rupture and drainage, or necrosis of the overlying skin, with or without concomitant bloodstream infection, may be observed (Mermel et al., 2009).

2.3.2. Significant bloodstream infection

An episode of 'significant' bloodstream infection was defined as an episode of bacteremia or fungemia, in which those pathogens were present in ≥1 blood cultures. We considered commensal microorganisms (coagulase-negative staphylococci [CNS], *Corynebacterium* spp. [except *Corynebacterium jeikeium*], *Lactobacillus* spp., *Bacillus* spp., and *Propionibacterium* spp., or viridans group *Streptococcus* isolates, and *Clostridium perfringens*) as probable pathogens when they were recovered in ≥2 blood cultures (2 separate needle sticks). In the case of neonates, given the difficulty in obtaining blood from these patients and following standard recommendations, we accepted as significant the presence of CNS or other potential contaminants in both bottles of a single venous puncture. Only the number of patients —not the number of blood cultures—was taken into consideration. All microorganisms isolated from blood from the same patient within 1 week were considered a single episode.

2.3.3. Gold standard for port colonization

A positive tip culture by the Maki roll-plate technique (≥15 CFU/plate) and/or sonication (≥100 CFU/plate) and/or a positive quantitative culture (≥100 CFU/mL) of CABS, CAAS, PSF, and/or a positive qualitative culture of ISB.

2.3.4. Gold standard for VAP-RBSI

Isolation of the same microorganism(s) at any site on the colonized port and in at least 1 peripheral blood culture.

2.4. Statistical analysis

Qualitative variables are expressed as a frequency distribution and quantitative variables as mean and SD or median and interquartile range (non-normal distribution).

Validity values were defined as follows: sensitivity, proportion of colonized catheters detected by the tested culture from the total colonized catheters detected by the gold standard; specificity, proportion of non-colonized catheters detected by the tested culture from the total non-colonized catheters detected by the gold standard; positive predictive value, proportion of colonized catheters detected by the tested culture matching colonized catheters detected by the gold standard from the total colonized catheters detected by the tested culture; negative predictive value, proportion of non-colonized catheters detected by the tested culture matching non-colonized catheters detected by the gold standard from the total non-colonized catheters detected by the tested culture. We recorded the validity values of Gram stain and culture of all VAP sites individually and in groups of 2 and 3.

Concordance between the roll-plate technique and sonication was assessed using the Kappa index with a 95% confidence interval, and the hypothesis of an index other than zero was contrasted. Statistical significance was set at $P \leq 0.05$.

The statistical analysis was performed using SPSS® 16.0 and EPIDAT®.

2.5. Ethics

The study was approved by the local ethics committee.

3. Results

During the study period, we included 223 ports from 222 patients. Median indwelling time was 440 days (interquartile range [IQR], 212–907 days). The main underlying disease was colorectal cancer (23.0%). Most catheters were removed because of end of use (60.5%), suspicion of bloodstream infection (19.7%), and a miscellany of other reasons (19.7%). Patient and catheter characteristics are detailed in Table 1.

The overall catheter tip colonization rate was 23.8% (53/223), and the isolated colonizing microorganisms were distributed as follows: Gram positive (76.5%), Gram negative (11.8%), and fungi (11.8%) (Table 2). The most frequently isolated microorganism was *Staphylococcus epidermidis* (39.7%).

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