

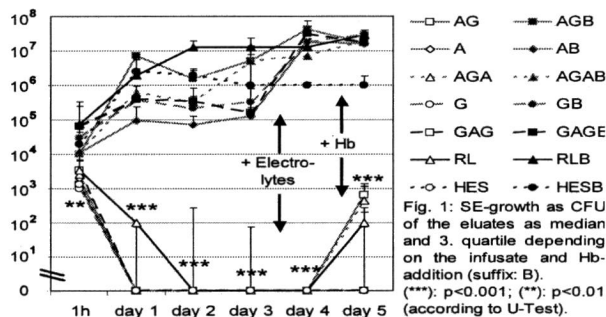
CVC COLONIZATION, PROLIFERATION, BIOFILM PRODUCTION AND RISK OF INFECTION BY STAPHYLOCOCCUS EPIDERMIDIS IS CONSIDERABLY AGGRAVATED BY ENDOLUMINAL BLOOD CONTAMINATION

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Background: Catheter-associated infections, esp. by Staphylococcus epidermidis (SE), are frequent complications in intensive care medicine. In 70 % spreading occurs endoluminally in the catheter¹, esp. after the 4th day of use. The objective was to determine the influence of blood contamination of catheter lumina or infusion solutions by sampling/reflux of blood on CVC colonization, proliferation, biofilm production and therefore risk of infection by SE. In perioperatively removed material we had determined a blood contamination of about 1 % Hemoglobin related to the endoluminal volume before.

Methods: Antimicrobially uncoated, orthogradly perfused (constantly 50 ml/d) permanently incubated at 37°C (= 98.6 F) single-lumen polyurethane catheters were endoluminally colonized with biofilm-producing SE (10⁶ colony-forming units/ml (CFU)) in amino acid 5 % -glucose 5 % mixture (AG) for 8 hours and perfused with sterile infusion solutions for 5 days thereafter: In parallel experiments 7 solutions each pure and with 1 % hemolysed human erythrocytes (Hb) added were tested (14 series at 14 catheters each): 1. AG, 2. 10 % amino acids (A), 3. 10 % glucose (G), 4. A, but on day 2 just G (AGA), 5. G, but on day 2 just A (GAG), 6. Ringer Lactate (RL), 7. Hydroxyethylstarch (200 kD/0.5) 6 % (HES). On day 4 electrolytes were added to reach human physiological values and on the 5th day 1 % Hb. Bacterial growth inside catheters was daily determined as CFU by culturing of dilution series from the liquids dripping off the catheters on blood agar plates. Following test end biofilm-bound bacteria were counted as CFU/catheter after detaching the biofilm from each shredded catheter and separating bacteria both by ultrasound. Statistics: Mann-Whitney U-Test (U), paired Wilcoxon-Test (W), both Bonferroni-corrected.



Results: In contrast to the blood-contaminated catheters permanently producing large numbers of bacteria the CFU from the liquids dripping off the Hb-free perfused catheters were already 5-fold (A, AGA) to 30-times (G, GAG, RL) lower (p<0.01; U) after one hour. On day 1 apart from RL, on day 2 to 4 all Hb-free came out as sterile, yet adding Hb on day 5 resulted (except for G, GAG, HES) in a significant CFU increase (Fig. 1, p<0.05; W), nevertheless the amount of biofilm-bound bacteria remained on average even here with 5x10³ (formerly Hb-free) vs. 2x10⁸ (permanently blood-contaminated) CFU per catheter considerably lower (p<0.001; U).

Interpretation: Bacterial colonization, proliferation, biofilm production and releasing to the infusate are significantly enhanced by blood contamination as well as the adherence to catheter walls because growth even under the best conditions imaginary considering a generational time of approx. 20 min may only result in 8-times as much bacteria within one hour but not in a 30-fold increase which means that with Hb present more bacteria must have remained adhered initially. Therefore reduction of blood aspiration or reflux to the very necessary may help to reduce the incidence of CVC infections.

Literature: ¹Sitges-Serra et al., World J Surg, 23, 1999, 589-595

Summary: Blood contamination of central venous catheters lightens primary adherence of Staphylococcus epidermidis (SE), massively enhances colonization, proliferation, biofilm production and therefore increases the risk of catheter-related infections by SE. Consequently reduction of blood aspiration through or reflux to catheters causing blood contamination of them to the very necessary may help to reduce the incidence of clinically relevant CVC infections by SE.