
Testing of the Antimicrobial Effect of Catheter Tubing with a Roll Culture Method

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Problem

Infections are a serious complication of catheters. Even with best surgical technique and utmost aseptic handling measures catheter associated infections cannot be avoided completely (1, 2, 3, 5).

Plastics that are impregnated with antibiotics have been used to fight infections (Zabramski). However, antibiotics can generate resistancies when used prophylacticy. Also an increasing proportion of device-related infections are caused by *Candida* (4).

Spiegelberg KG developed a catheter material for ventricular catheters (Silverline) that is impregnated with a combination of antimicrobial substances. The substances used are 1% of nano-particles of silver and 1% of nano-particles of a unsoluble silver salt. Silver ions are a strong antiseptic with a broad spectrum (6, 8).

The nanometer-size particles have a large specific surface resulting in the release of silver ions in antiseptic concentration on the surface of the catheter.

The silver salt starts to release silver ions in antiseptic concentration immediately after placement of the catheter. The release of silver ions from the silver particles starts several hours later, when the ion release from the silver salt slows down. The release of silver ions from the silver particles then continues over a long interval.

Currently no standardized method to assess the antimicrobial properties of plastic materials is available. The aim of this study is to standardize a roll culture method previously described by Guggenbichler (3) and to use it to assess the antimicrobial properties of the new material.

Method

Seven different species were used to assess the antimicrobial effect:

- *Staph. aureus* ATCC 25923
- *Staph. epidermidis* BK 4460 isolated from a catheter associated infection in the laboratory of University of Erlangen
- Methicillin resistant *Staphylococcus* (MRSA) from the laboratory of the University Hospital Eppendorf, Hamburg
- *E. coli* ATCC 25922
- *Pseudomonas aeruginosa* ATCC 27853
- *Candida albicans* ATCC 10231
- *Candida clabrata* ATCC 90030

For the species suspensions of the cells were used on the material under test and on a control of the same material not impregnated with antiseptics.

The germs were incubated for 12 hours after which dense groth was observed. Then one inoculation loop of each testing material was transferred to 10 ml of sterile physiologic saline. The solution was then thoroughly mixed on a Whirl-Mix until a homogeneous suspension resulted.

Taking out .5 ml of the respective suspension and transferring it to a vessel of 5 ml of saline a concentration of about 10^8 /ml was generated.

Two samples of catheter tubing were tested:

- Tecoflex 80 A + 18% of BaSO₄ + 2% of antimicrobial substance
- Tecoflex 80 A + 20% BaSO₄ (control)

Pieces of a length of 5 cm of the materials were placed in the vessels. The vessels were incubated at 37 C for 3 h.

Then the samples were taken out of the suspension, all droplets were shaken off and the samples were rolled back and forth over the surface of a Petridish with blood-agar (Oxoid). Then they were transferred into 5 ml of fresh sterile saline. Taking out and rolling was repeated every 3 h. The samples were transferred back into the medium after each roll process. The plates were incubated at 37 C. The observation was done four hours after the roll process.

Results

Antimicrobial effects were observed for

- Staph aureus after 6 hours,
- Staph epidermidis after 15 hours,
- E. coli after 12 hours,
- Pseudomonas aeruginosa after 18 hours
- Candida spp. after 16 hours.

Table 1 shows the results. Picture 1 shows cultures of the Silverline Catheter and of the non-antimicrobial control after subjecting them to a suspension of *Candida* spp. The top rows are

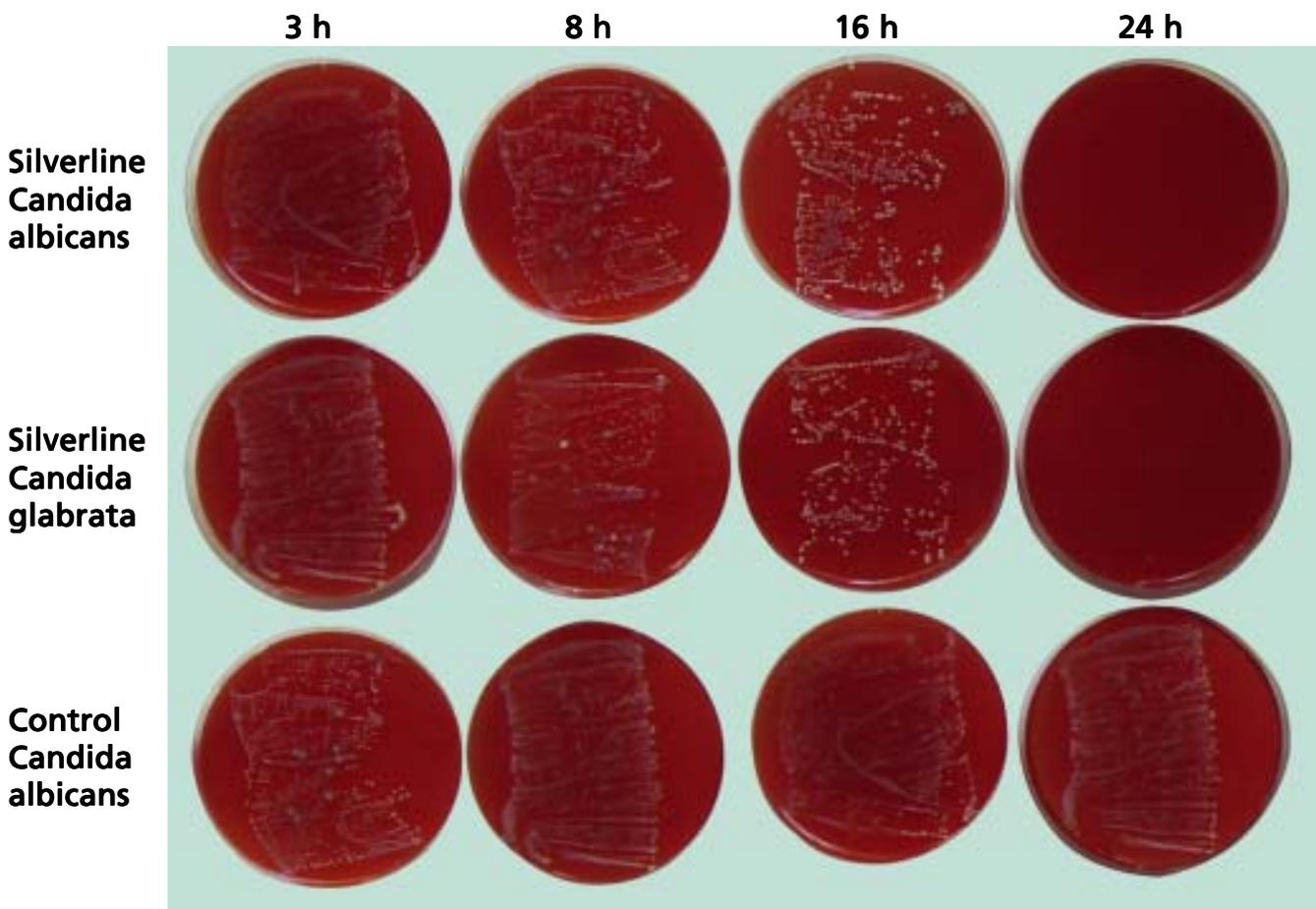
cultures of the Silverline Catheters after certain time intervals. The lower row is the control.

Discussion

The antimicrobial effect of Silverline Catheters could be shown in the in-vitro trial in a spectacular manner. The broad spectrum of efficacy against hospital bacteria and yeasts gives the product a very good effect.

Silver as an antimicrobial substance has been known for a long time. The effect was first described by v. Naegeli (6) in 1893. Silver has been used in central venous catheters for some time (Erlangen Silver Catheter). A commercially available CVC that uses the same combination of antiseptic substances which is used in the Silverline Catheters, showed a significant reduction in the infection rate in controlled studies (2, 3).

Because of its broad band effect with no danger of resistancies the Silverline Catheters are a new element for fighting infection of ventricular catheters.



Picture 1: Roll cultures of Silverline tubing and control tubing after inoculation with *Candida* spp. and intervals of incubation

Incubation time			3h	8h	16h	24h	32h
Cell	Tubing	Cell concentration					
Staph. aur. ATCC 25923	Silverline	2.8 x 10 ⁸ / ml	5	2	1	0	0
	Control	2.8 x 10 ⁸ / ml	5	5	5	5	
Staph. aur. MRSA UKE Hamburg	Silverline	5.9 x 10 ⁸ / ml	5	5	1	0	0
	Control	5.9 x 10 ⁸ / ml	5	5	5	5	
Staph. epi. BK 4460	Silverline	7.4 x 10 ⁷ / ml	5	1	0	0	0
	Control	7.4 x 10 ⁷ / ml	5	4	3	3	
E. coli ATCC 25922	Silverline	6.7 x 10 ⁷ / ml	5	1	0	0	0
	Control	6.7 x 10 ⁷ / ml	5	5	5	5	
Pseudom. aeruginosa ATCC 27853	Silverline	6.9 x 10 ⁸ / ml	5	5	2	1	0
	Control	6.9 x 10 ⁸ / ml	5	5	5	5	
Candida albicans ATCC 10231	Silverline	7.2 x 10 ⁷ / ml	5	5	3	0	0
	Control	7.2 x 10 ⁷ / ml	5	5	5	4	4
Candida glabrata ATCC 90030	Silverline	6.1 x 10 ⁷ / ml	5	5	3	0	0
	Control	6.1 x 10 ⁷ / ml	5	5	5	4	4

Table 1: Observations of roll cultures of Silverline tubing and control tubing after inoculation and intervals of incubation

5 = dense growth

4 = strong growth

3 = growth

0 = no growth

Bibliography

- Anneke, A.: Infektiöse Komplikationen von Liquoraußendrainagen. Dissertation Universität Heidelberg, 1999
- Guggenbichler, J.P.; Juhl, G.; Braun, G.G.; Fraß, M.; Künstle, O.A.; Plötz, J.; Saffartzik, W.; Steinhäuser, M.; Wenisch, C.: Klinische Untersuchungen mit einem neuen Nano-Silber imprägnierten zentralvenösen Katheter. Hyg Med 28, 2003, 228-34
- Guggenbichler, J.P.: Central Venous Catheter Associated Infections Pathophysiology, Incidence, Clinical Diagnosis, and Prevention - A Review. Mat.-wiss. u. Werkstofftech., 34, 2003, No. 12, 1145-54
- Kojic, E.M.; Darouiche, R.O.: Candida infections of medical devices. Clin. Microbiol. Rev., 17, 2004, 255-267

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5. Lozier AP, Sciacca RR, Romagnoli MF, Connolly ES Ventriculostomy-related infections: A critical review of literature. *Neurosurgery* 51, 2002, 170-182
 6. Naegeli, C. v.:Über die oligodynamischen Erscheinungen an lebenden Zellen. *Neue Denkschr. Allg. Schweiz. Ges. Naturwiss.* 33, 1893, 174 - 182
 7. Pfisterer, W.; Mühlbauer, M.; Czech, T.; Reinprecht, A.: Early diagnosis of external ventricular drainage infection: results of a prospective study. *J Neurol Neurosurg Psychiatry* 74, 2003, 929–932
 8. Thurmann, R.B.; Gerba, C.H.P.: The molecular mechanisms of copper and silver ion disinfection of bacteria and viruses. *Crit. Rev. Environmental Control*, 18, 1989, 295-315
 9. Zabramski J.M.; Darouiche, R.O. et al.: Efficacy of antimicrobial-impregnated external ventricular catheters: a prospective, randomized, controlled trial. *J Neurosurg*, 98, 2003, 725-730

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