

[1]周薇,沈犁,张燕,等.穿心莲内酯抗金黄色葡萄球菌生物膜作用及其与庆大霉素的协同作用[J].第三军医大学学报,2014,36(16):1694-1698.

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## 穿心莲内酯抗金黄色葡萄球菌生物膜作用及其与庆

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Title: Effect of andrographolide against *Staphylococcus aureus* biofilm and its synergistic activity with gentamicin

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关键词: 生物膜; 金黄色葡萄球菌; 穿心莲内酯; 庆大霉素

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摘要: 目的 研究穿心莲内酯 (andrographolide, Andro)抗金黄色葡萄球菌 (*Staphylococcus aureus*, *S.aureus*) 生物膜作用及其与庆大霉素(gentamicin, GEN)的协同作用。 方法 选择金黄色葡萄球菌ATCC25923以及2株临床菌株CY001与CY002进行研究。比浊法测定Andro (浓度100  $\mu\text{g}/\text{mL}$ ) 对*S.aureus*各菌株生长的影响; 建立*S.aureus*生物膜体外模型, 分为对照组、Andro干预组、GEN干预组以及Andro与GEN联合干预组, 结晶紫染色后, 用酶标仪在600 nm波长处测定光密度值 $D(600)$  间接观察各组生物膜的形成能力; 扫描电镜观察各组生物膜的结构。 结果 100  $\mu\text{g}/\text{mL}$  Andro作用下*S.aureus*各菌株生长曲线与对照组相比无显著性差异 ( $P>0.05$ ); 除CY002由于不形成生物膜, 各组间两两比较均无明显差异外 ( $P>0.05$ ), CY001与ATCC25923在各干预条件下生物膜均较对照组减少 ( $P<0.001$ ), 其中100  $\mu\text{g}/\text{mL}$  Andro对生物膜的抑制作用强于50  $\mu\text{g}/\text{mL}$  GEN ( $P$ 值分别为0.001, 0.003), 两者联用时的抗生物膜作用明显增强 ( $P<0.05$ )。扫描电镜观察提示各干预条件对*S.aureus*生物膜均有

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抑制作用，以Andro与GEN联合的抑制作用最为明显。结论 Andro对*S. aureus*无直接杀菌作用，但对*S. aureus*生物膜具有良好抑制作用，与GEN联合应用，具有协同抗生物膜作用。

**Abstract:** **Objective** To investigate the effects of andrographolide (Andro) against *Staphylococcus aureus* (*S. aureus*) biofilms and its synergistic activity in combination with gentamicin (GEN). **Methods** Turbidimetric method was used to detect the effect of Andro (100 µg/ml) on *S. aureus* growth curve. *S. aureus* ATCC25923 and 2 clinical strains CY001 and CY002 were used for biofilm formation *in vitro*, dividing into a control group, an Andro intervention group, a GEN intervention group and an Andro combined with GEN intervention group. A microplate reader was used to detect the OD600nm values and indirectly observe the biofilm formation ability of each group. Scanning electron microscopy (SEM) was used to directly observe morphology of biofilms treated with different interventions. **Results** Under the action of 100 µg/mL Andro, the growth curve of each strain had no difference as compared to the control group ( $P>0.05$ ). Except for CY002 that could not form biofilm, there was no significant difference between the groups ( $P>0.05$ ). The biofilms of CY001 and ATCC25923 in each intervention groups were less than those in the control group ( $P<0.001$ ). The inhibition effect of 100 µg/mL Andro was stronger than that of 50 µg/ml GEN ( $P=0.001$ ,  $P=0.003$ ), and the inhibitory effect of the combination intervention group was obviously stronger than that of the Andro intervention group and GEN intervention group ( $P<0.05$ ). Morphology observation under SEM prompted that each intervention condition had inhibitory effect on *S. aureus* biofilm, while the combination intervention group had the strongest effect. **Conclusion** Andro has no significant effect on the growth of *S. aureus*, but has excellent inhibitory effect on the biofilms of *S. aureus*. Moreover, Andro and GEN have synergistic inhibitory effect.

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