Release of Polyhexamethylene biguanidine hydrochloride (PHMB) from a Hydrobalanced cellulose wound dressing with PHMB*

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Introducing

Beside their low healing tendency, chronic wounds frequently show bacterially infections even with multiresistant micro-organism like MRSA. Because of the variety of bacteria found in such critically colonized or infected wounds, the usage of an antimicrobial compound with a broad spectrum of action is required. Due to their broad antibacterial properties and low toxicity biguanides like PHMB are preferred for modern wound-treatment. In Hydrobalanced cellulose dressings with PHMB*, Polyhexamethylene biguanidine hydrochlorid is added as an antimicrobial agent. The purpose of the following study was to determine the amount of released PHMB on the time observed.

Material and Methods

Release studies of PHMB from hydrobalanced wound dressings with PHMB* were performed, using static and dynamic extraction methods. Aliquotes of the extraction media were analysed by HPLC and the amount of the released bactericidal agent was determined by using the external standard technique. A calibration curve within a range from 5 to 100 ppm of PHMB was recorded before every measurement. For detection of PHMB a DAD (dioden array detector) at 236nm was used. For the static extraction, wound dressings were cut into pieces with an average weight of one gram, transferred into petri dishes containing 20 ml of physiological NaCl- solution and incubated on an orbital shaker. After different time periods, the extraction was stopped by removing the wound dressings from the petri dishes.

The experimental setup for the dynamic extraction is shown in Fig. 1. For this technique the flow rate was set to 3 ml per hour..

The Kirby-Bauer technique was used for microbiological investigations. We wanted to evaluate the antimicrobial effect of selected extracts against *staphylococcus aureus* ATCC 6538P (gram positive) on a CSA (casein,soy-bean, Agar) plate. The used bacterial solution had a microbial count of $1x10^6$ CFU (colony forming units) which were determined by plating and counting of colonies.

Results

As Figure 2 demonstrates, nearly the whole amount of PHMB contained in the wound dressing is released during 24 hours (> 75%) when the static extraction mode is performed. Especially in the first hours of measurement, the concentration of the bactericidal agent in the extraction medium increases fast and almost linear. After four hours more than 60% of PHMB have been released (Fig.3). For the dynamic extraction, it was observed that the majority of PHMB was washed out after 24 hours. As shown in Figure 4 a maximum release of 55% of PHMB was reached after 2 hours.

Microbiological investigations showed good zones of inhibition for the extracted NaCl solutions (Fig 5). As expected the zone of inhibition for the 24 h extract is bigger than that for the 1 h extract.

Conclusion

Because of its ability to release high amounts of PHMB shortly after application, a bactericidal activity is achieved fast when using hydrobalanced wound dressings with PHMB* for the treatment of infected wounds. Interactions between the positive charged PHMB molecules and the cellulose-fibers are obviously reduced by the ultra-fine network structure in the wound dressing. Due to the known minimum inhibition concentration (MIC) and the clinical experiences, the observed concentration of about 0,25% polyhexamethylenebiguanidine hydrochlorid in the extraction medium is convenient to be effective against a wide variety of bacteria. Hydrobalanced dressings with PHMB are therefore accurate for treating critically colonized or infected wounds.

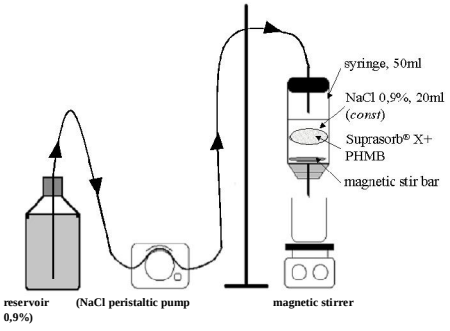

Fig. 1: Experimental setup for the release rate of PHMB from a Hydrobalanced dressing with PHMB with a dynamic method. The arrows indicate the flow direction.*

Hydrobalanced dressing with PHMB = Suprasorb® X + PHMB

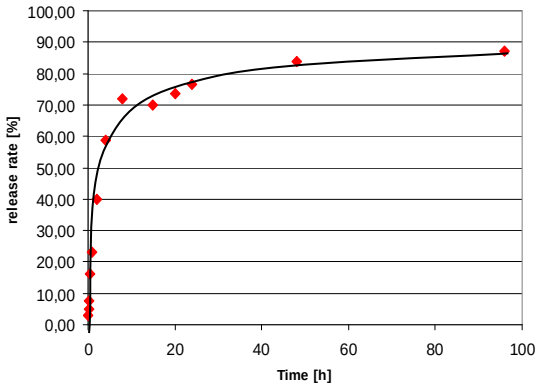

Fig. 2: Release rate of PHMB form a Hydrobalanced dressing with PHMB with a static method.*

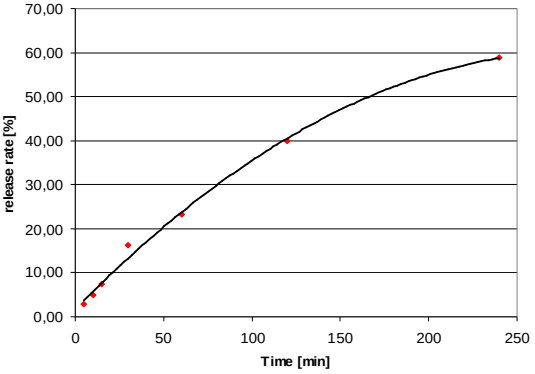

Fig. 3: Release release of PHMB from a Hydrobalanced dressing with PHMB during the first 4 hours with a static method.*

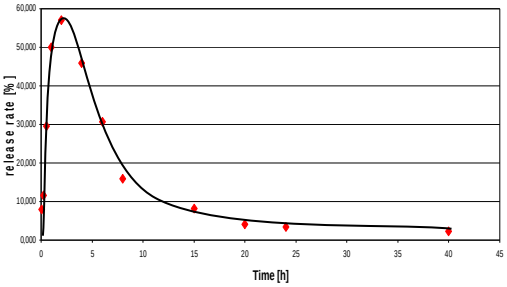

Fig. 4: Release rate of PHMB from a Hydrobalanced dressing with PHMB with a dynamic method.*

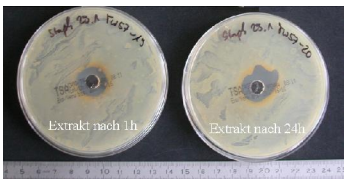

Abb. 5: Zone of inhibition of a NaCl- solution after 1 or 24 h contact with a Hydrobalanced dressing with PHMB.*

References

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