

On the mechanism of drug release from polymethylmethacrylat (PMMA)

B. Lindner

Borstel Research Institute, Department of Biophysics,
D-2061 Borstel, Germany (F.R.)

It is an established and successful method to use Gentamicin loaded bone cement to reduce the incidence of deep infections following hip-joint endoprosthesis surgery /1/. Nevertheless there is little understanding about the mechanism leading to the release of drugs from the bone cement consisting of PMMA.

With the aim of testing the various assumptions on possible release mechanisms an experimental method was developed allowing the in vitro measurement of:

1. the amount of drug released from small PMMA-cylinders,
 2. the concentration profile within the cylinders
- in dependence of time up to 500 days. By implanting small bone cement cylinders containing Gentamicin into the femur of rabbits it was possible also to control the release under in vivo conditions. Radio-immuno-assay methods were used to detect the antibiotic.

From a comparison of the experimental results with computed data obtained from the theoretical models of the drug release it can be excluded that the release is based only on the elution of drug-crystals being in contact with the surface of the bone cement /2/. Also the following assumptions failed in describing the measurements:

1. leaching out by a system of interconnecting micro-channels in the PMMA filled with the fluid surrounding the sample /3/,
2. transportation from the interior to the surface only of that part of the drug being solved in the polymer by diffusion in the fluid phase /4/.

However, the assumption of solid state diffusion leads to a good agreement between the theoretical calculation and the data obtained as well from the in vitro as from the in vivo experiments.

- /1/ Buchholz, H.W. (1973), Proceedings of the 1st International Congress on Prosthetics Techniques and Functional Rehabilitation, Wien 1973.
- /2/ Wroblewski, B.M. (1977), Clin. Orthop. 124, 311-312.
- /3/ Gardner, A.D.H. (1974), The Lancet 2(10), 891.
- /4/ Knappwost, A., Gerlach, D. (1976), Naturwissenschaften 63, 196.