BLOOD IN CONTACT WITH ARTIFICIAL SURFACES

WIESŁAWA OKRÓJ, MAREK KACPRZYK, GRZEGORZ BOGUSŁAWSKI,
LESZEK KLIMEK, STANISŁAW MITURA and BOGDAN WALKOWIAK
Institute of Materials Engineering and Science, Technical University of Łódź,
Stefanowskiego 1, 90-924 Łódź, Poland

The implant surface, especially in contact with blood, should be resistant to protein deposition and cellular adhesion. Currently available materials, no matter how generally accepted for medical purposes, only partially meet this requirement. Significant effort was recently focused on new materials based on thin layer crystalline carbon technology. At present, efficient and low cost technology for surface coating with diamond-like carbon (DLC) and nanocrystalline diamond (NCD) is available. DLC and NCD layers can be created on any surface, with a preference for metal surfaces. The layers are produced using the radio frequency chemical vapor plasma deposition (RF PCVD) method, with the use of methane as a source of carbon. Coatings prepared this way are characterized by a very high degree of hardness, like diamond, a low friction coefficient and high chemical resistance. Due to the extremely high level of adhesion to the coated surface, it is very durable. Although DLC and NCD coatings were already applied in bone and cardiovascular surgery and dentistry, to date these surfaces were not satisfactorily characterized with respect to their compatibility with blood. We decided to compare medical steel (AISI 316L) samples and medical steel samples coated with NCD with regard to their susceptibility to blood platelet adhesion to their surfaces. After one hour of contact between the samples and flowing citrated human blood, and an extensive washing with phosphate buffered saline (PBS), the samples were preserved with glutaraldehyde, dried and then covered with a thin layer of metallic gold. Samples prepared in this way were used for scanning electron microscope (SEM) examination. Selected areas were magnified and photographed. At the surface of the medical steel, numerous adhered platelets and platelet aggregates were visible. All the platelets had a dendrite-like shape with characteristic long insets (pseudopodia). Clots with immobilized platelets and other cells were also sporadically observed. In the case of medical steel coated with NCD, huge surface areas were free from adhered platelets. Separate leukocytes, erythrocytes or discoid platelets could very seldom be found. Only at damaged fragments of the NCD surface could adhered platelets and other cells be detected. Our results unequivocally indicate the high merits of NCD in contact with human blood.