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Endothelialisation of Cardiovascular Implants – A Matter of Concern

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Cardiovascular Implants

Cardiovascular implants have been introduced into clinical practice for a broad spectrum of indications. Devices can be implanted at almost every location throughout the cardiovascular system. Beside the surgical route, many other ways and methods have been developed for bringing the implant to its destiny in the human body. Heart surgeons, vessel surgeons, neurosurgeons, radiologists, cardiologists and pediatric cardiologists routinely perform implantations of a large variety of devices into blood vessels or into the heart.

But independent of which type of implant found its final destination where or how, and who performed the procedure: the implant is and will remain a foreign body. Foreign body surface exposure to the bloodstream is inevitable. This implies that there is a substantial risk of superficial thrombus formation with the inherent risk of subsequent embolisation and further organ damage [1]. In this context, re-endothelialisation of cardiovascular devices following implantation is of major relevance since the presence of endothelium is considered the natural and most effective prevention of superficial thrombus formation [2]. But the time gap after an interventional procedure until complete re-endothelialisation has occurred has to be bridged for minimizing the risk of thromboembolic complications. In order to reduce this risk antiplatelet therapy is usually recommended for weeks or months although proper guidelines are missing except for prophylaxis against thrombus formation after coronary stent implantation [3,4] and following aortocoronary bypass surgery [5]. For all other implants and indications, the best mode and duration of anticoagulant or antiplatelet therapy is largely unknown.

With the intent to find the right way to sufficiently prevent thrombus formation on the surface of cardiovascular devices, the following question has to be answered: What is the time course of re-endothelialisation?

Data from histological work-up of cardiovascular implants demonstrate that re-endothelialisation does occur. But there is little information on the time course of this process. Most authors state that formation of superficial endothelium on vascular foreign bodies happens within three to six months [6-8]. But this process, however, may be significantly prolonged in certain clinical situations. It was demonstrated that thrombus formation can definitely occur later [9-11].

How can we close this gap? All implants that need to be explanted for any reason should be carefully evaluated histologically with the focus on endothelialisation in order to better understand mechanisms and the time course of re-endothelialisation. Careful and detailed evaluation, however, is not easy to perform since standard processing with paraffin embedding is not applicable to tissue specimen containing metal parts or other foreign materials [8]. Embedding in a hard resin such as methylmethacrylate and subsequent sawing and grinding is required in order to obtain histological slides without destruction of the implant-tissue interface as well as that of the endothelium [12]. It is even more challenging to produce immunohistochemial staining in these specimen which allow for explicit identification of endothelium specific antigens such as von-Willebrand factor or CD-31 [13,14].

Improved data from histological studies will provide a better basis for indication, type, and duration of antiplatelet therapy in a wide spectrum of clinical situations. Data derived from explanted devices should be brought together with data obtained from clinical studies. This knowledge should serve as fundament for establishing updated guidelines for the management of patients after implantation of an intracardiac or intravascular device. But nevertheless, it is mandatory that every patient is followed by repeated clinical and sonographic examinations on a regular basis in order to detect possible problems such as thrombus formation. And it is mandatory as well that every explanted device should undergo thorough histopathological work-up in a center with expertise in the processing of metal containing tissue specimen.

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