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Preface

Cell-cell interactions via direct membrane contacts are a fundamental part of many biological processes, e.g. morphogenesis and reproduction as well as the pathogenesis of various diseases. A particularly fascinating subgroup of such interactions are those that are mediated via the apical plasma membrane of epithelia. The apical cell pole of polarized epithelial cells is traditionally thought to be specialized to resist adhesive interactions with other cells; however, such interactions do occur in this specific part of cells during certain important biological events, e.g. at the surface of activated endothelial cells during leukocyte extravasation, and during the initial phase of embryo implantation when the trophoblast of the blastocyst contacts the uterine epithelium.

In January 2001 a symposium with internationally renowned speakers was held at the Institute of Anatomy, University of Essen Medical School (Germany) to discuss recent advances in our understanding of the cell biology of these processes and to provide a platform for contacts and the exchange of ideas between scientists from these different fields. This special issue of *Cells Tissues Organs* contains extensive and updated reviews based on some of the presentations given at that symposium with topics ranging from recent advances in vascular biology to novel aspects of embryo implantation, including modern approaches involving nanotechnology for the study of living cells at the molecular level.

The first two contributions, from the groups of Imhof and Vestweber (Aurrand-Lions et al.; Wild et al.), discuss fundamental aspects of the interaction of leukocytes with endothelial cells of the vascular wall. Aurrand-Lions et al. show new data on the role of JAM-2 molecules in endothelial cells in facilitating lymphocyte transmigration, and Wild et al. present new data about the role of P-/E-selectins and their ligands during the initial processes of leukocyte adhesion and their malfunction in the case of leukocyte adhesion deficiency (LAD II).

Benoit and Gaub then describe recent developments in the application of the atomic force microscopy (AFM) technology (force spectroscopy) for monitoring the interaction between single molecules, specifically the measurement of inter- and intramolecular forces. The basic principles of application of this technology to the measurement of adhesive forces between cells are discussed.

The last part focuses on the interaction between the trophoblast and the uterine epithelium during the initial phase of embryo implantation. Wang and Armant describe their experiments on integrin-mediated adhesion and signalling in the adhesion-competent mouse trophoblast. Burghardt et al. present data about the role of integrins and their ligands during trophoblast interaction with the uterine epithelium in various animal models, focusing on large farm animals. Hohn and Denker concentrate again on the trophoblast aspect and discuss a series of experiments concerning the regulation of two of the biological properties of thophoblast: its adhesiveness for the uterine epithelium and its ability to penetrate the extracellular matrix (invasiveness). Finally, Thie and Denker present experiments in which adhesive forces have been measured between trophoblast and uterine epithelium during attachment, using the AFM/force spectroscopy approach discussed before by Benoit and Gaub. They conclude that the state of 'receptivity' of the uterine epithelium, which previously has been little understood in terms of cell biology, may be characterized by the ability to initiate intracellular calcium signalling via apically localized integrins and that these need to be functionally interconnected with an intact actin cytoskeleton.

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When these various contributions are viewed together a major aspect becomes apparent. It seems to make good sense to compare different biological systems in terms of cell biology. Cascades of events taking place during leukocyte rolling, adhesion and transmigration through the endothelium, including signalling processes, do show some similarities with what is going on between the trophoblast and the uterine epithelium during the initiation of embryo implantation. Details are different, of course, with respect to the time scale, the identity of the involved adhesion molecules and the individual signalling processes. But experimental tools have now become available to find out about these details, not only gene knockout technologies, but also other experimental approaches involving high-resolution confocal microscopy combined with an investigation of signal transduction events, as well as measurement of defined forces at the nano- and pico-scales, using e.g. the force spectroscopy approach. We can all expect to see exciting news in the course of the next few years when these lines of research are pursued.

I would like to thank all authors for having contributed their fascinating data and viewpoints. Special thanks are due to my collegues, Gudrun Mikus, Hans-Peter Hohn and Michael Thie for their help with organizing the symposium, and to Dr. h.c. Thomas Karger as well as the Deutsche Gesellschaft für Zellbiologie (DGZ), the Gesellschaft für Entwicklungsbiologie (GfE) and the Gesellschaft für Zell- und Gewebezüchtung (GZG/ETCS) for financial support. I would also like to thank Linda Haas and Stefan Sessler for their continued excellent cooperation in the *Cells Tissues Organs* editorial office and the production department of the publishing house.

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