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You can't lose
at the
ISHRS 15th Annual
Scientific Meeting.
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Improving the Revascularization of Transplanted Hair Follicles Through Up-Regulation of Angiogenic Growth Factors

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Hair follicles are avascular, like the interfollicular epidermis, and their growth is surrounded by perifollicular blood vessels arising from a deep plexus (the "fascial network") into subcutaneous adipose tissue and deep dermis. The capillary loops around the hair follicle nourish the hair bulb and dermal papilla cells through a rich blood supply.

Many studies have shown that hair growth depends on the induction of angiogenesis to meet the increased nutritional needs of the rapid cell division of hair follicle during the anagen phase, and that the number and diameter of perifollicular vessels significantly decrease during catagen and telogen (with more than fourfold reduction in perifollicular vessel size). It has been demonstrated that the hair follicle provides its own angiogenic stimulus, and that the angiogenic activities are related to the different phases of the hair cycle.

The real molecular mechanism of vascular control is not yet well known. Vascular endothelial growth factor (VEGF) plays an essential role in mediating angiogenesis during development of the hair cycle. VEGF enhances angiogenesis as well as microvascular permeability increasing the vessels' size during anagen. These changes coincide with the increasing size of hair follicles.

The enhancement of perifollicular vessels is mediated by the up-regulation of VEGF mRNA by cells of the dermal papilla and outer root sheath keratinocytes, with the consequent growth of hair follicles and hair shafts.

The hair growth depends also on the up-regulation of other growth factors such as fibroblast growth factor-7, insulin growth factor-1, and the direct stimulation of specific receptors of tau-rine and ornithine in the outer root sheath.

Transplanted hair follicles are avascular immediately after transplantation. One of the critical moments of hair transplantation can be the risk of an ischemia reperfusion injury of the hair grafts because of poor revascularization, and non-specific inflammatory response.

Transplanted hair follicles must find the best condition in the scalp to start their life-long cyclic transformation. To survive, transplanted follicles need to avoid ischemia reperfusion injury, to meet the increased nutritional need to stimulate the rapid proliferation of follicular keratinocytes and the elongation and thickening of the hair shaft. Many of the transplanted hair follicles slip into the resting phase (telogen) before passing to the growth phase (anagen): active and resting follicles differ remarkably in the metabolism and control mechanism. Adachi *et al.* showed that in active follicles, compared with resting ones, glucose utilization is increased by 200%, glycolysis by 200%, activity of the pentose cycle by

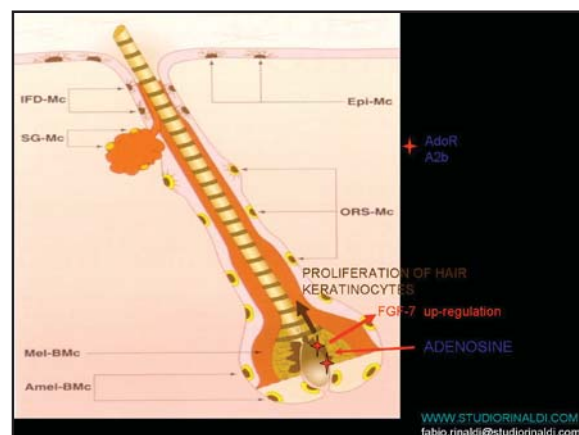


Figure 1. Adenosine sulphate directly stimulates the up-regulation of VEGF in dermal papilla cells *in vivo*, and the up-regulation of FGF-7 gene expression in DPC via specific receptor AdoR A2b.