Hair Transplant Forum International

INTERNATIONAL SOCIETY OF HAIR RESTORATION SURGERY

forum

Volume 14, Number 4 July/August 2004

Ischemia-Reperfusion Injury and Graft Storage Solutions

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Introduction

In the course of follicular unit transplantation, thousands of hair follicles are removed from one place and transplanted to another. We are all aware of the issue of growth and how important it is in achieving density and patient satisfaction. Most of us accept that the most important factor in obtaining optimal growth is avoiding physical trauma by transplanting physically intact hair follicles that have not been transected, dehydrated, or crushed. After this, we realize how important vascular perfusion in the recipient bed is to the survival of our grafts. Primary factors in reducing vascular perfusion are scarring from prior surgery and overzealous operative injury to the recipient bed with incisions that are too big or too dense. Beyond this, we recognize infection, idiopathic factors ("X factor"), and, perhaps, "something the patient did" in affecting the growth of our grafts.

However, another key consideration is what I call biochemical factors, something to which we as hair transplant surgeons have paid little attention. When surgeons transplant whole organs (e.g., livers and kidneys), they consider these factors as important as immunologic rejection in determining the viability of the transplant. Of course, careful immunologic matching and immunosuppressive medications help avoid rejection. A tremendous amount of research has been done to identify and overcome biochemical injury to transplanted tissue and organs, research that has direct implications for hair transplantation. These biochemical factors can be divided into ischemia-reperfusion injury (IRI) and storage injury.

IRI has been a research interest of mine for the past couple of years. Put simply, IRI is the biochemical injury to the transplants that occurs after they have undergone a period of low oxygen (ischemia) and then implanted in the recipient sites where they are exposed to oxygen (reperfusion). It's an automatic reaction that is only partially understood. What is known is that IRI results from the formation of "free radicals," sometimes called reactive oxygen species (ROS). This occurs in both the transplanted cells as well as the neutrophils present in the recipient tissue. These free radicals can be thought of as "molecular terrorists" that bounce around, injuring the inside and outside of the cell. Damaged cells within the hair follicle may result in suboptimal growth.

Does IRI injury occur in transplanted hair follicles? To answer this, I used a standard method of checking for free

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August 24–28, 2005