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Autologous plasma and its supporting role in fat graft survival: A relevant vector to counteract resorption in lipofilling

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Summary Fat grafting has become a widespread technique for different reconstructive and esthetic purposes. However, the disadvantage of fat grafting is the unpredictable resorption rate that often necessitates repetitive procedures, which in turn may have an impact on the morbidity. During the immediate, post-graft, ischemic period, cells survive due to the process of plasmatic imbibition. This biological phenomenon precedes the ingrowth of neo-capillaries that eventually nourish the graft and help establish a long-term homeostatic equilibrium. Both partners, the graft and the recipient bed, contribute to the revascularization process. Hypothetically, enrichment of the recipient site with autologous plasma could have a beneficial role to enhance fat graft survival. We investigated whether plasma supported the viability of the lipoaspirate (LA) material. Plasma was isolated from blood samples collected from eight patients during the elective lipofilling procedures. An in vitro study assessed the viability of LA cells using plasma as a culture medium compared to the traditional culture media. In vitro analysis confirmed sustained viability of LA cells compared to the standard media and control media during 7 consecutive days. The behavior of the fat grafts in plasma showed similarities with those incubated in the traditional culture media. In future, these findings could be translated to a clinical setting. Plasma is the only autologous substrate available in large quantities in the human body. The addition of the supporting agents, such as plasma, could contribute to a better graft survival with more stable clinical outcomes in the long term. The rationale behind the

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technique is based on the phenomenon of plasmatic imbibition and the reasoning that the extracellular matrix plays a pivotal role in cellular survival.

Introduction

The concern of fat grafting is the variable rate of resorption. Fat grafting succeeds at a microscale level by providing the appropriate cell type in a theoretically suitable microenvironment, but it often fails at a macroscale level, because a part of the transplanted cells is located >150 μm away from the blood vessels, which is the diffusion limit for oxygen and nutrients (Figure 1).[1] The biological phenomenon of plasmatic imbibition supports grafted cells to survive the immediate post-graft ischemic period.[1,2] The graft "drinks" plasma and absorbs nutrients to protect itself from desiccation. The post-graft period is undetermined. It varies depending on the tissue quality at the recipient site as well as the quality of the graft. For a skin graft, this may be up to 24 or even 48 h.[1,2] Scientific data regarding the immediate post-graft period of transplanted fat are inadequate. However, we can assume that plasmatic nutrition plays a crucial role and dictates the clinical outcome. It is well known that the adipose organ is a highly vascularized organ, and a rapid and efficient revascularization is crucial for fat graft survival.[3,4] The intention of lipofilling is to place a graft in a steady-state, homeostatic equilibrium. Homeostasis means that the graft has a well-balanced physiological interaction with its microenvironment. Rather than the addition of stimulatory agents, "supporting" agents would be superior to achieve this equilibrium without additional stimulation at a cellular level.[5] We were able to generate three-dimensional (3D) adipose constructs in rodents and observe the process of angiogenesis with the close relationship between angiogenesis and developing adipocytes.[6] Analysis of these data has contributed substantially to the understanding of fat graft behavior in vivo. The matrix is the main vector in processes of cellular migration, proliferation, and differentiation. It coordinates cell—cell and cell—matrix interactions in a geometrical 3D framework.[7—11] The lipofilling procedure is basically a "reversed reconstructive approach": a biological disharmony exists between the graft and the recipient site, as both need to contribute to the revascularization process crucial for achieving homeostasis.[1,2] Liposuction disrupts the extracellular matrix (ECM), and the subsequent processing of the lipoaspirate (LA) material jeopardizes cell viability due to a considerable degree of trauma.[12,13] The injection of this LA material places the graft in a new environment that lacks substantial nutritional support, whilst plasmatic imbibition will also have its spatial (graft volume) and temporal (post-graft period) limits.[1,2,14—16] The main determinant for cell survival is an appropriate, supportive microenvironment.[3—9,14—16] Following the "replace-like-with-like" principle and the prospectus of a future based on autologous approaches, we are considering plasma as a potential nutritional vehicle for fat grafts. This paper reviews the immediate post-graft period in fat grafting and hypothesizes the use of plasma as a medium to support fat graft viability and counteract resorption.

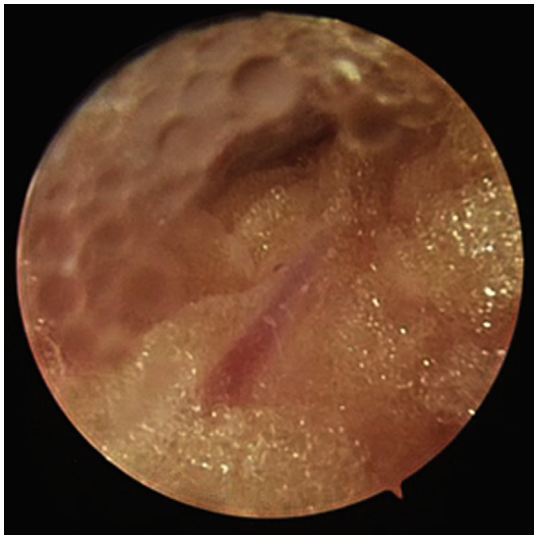

Figure 1 Endoscopic view after a lipofilling session: fat grafts are observed in proximity with a capillary. Those grafts survive the immediate post-graft period through plasmatic imbibition and before neo-angiogenesis, they are released from their ischemic condition.

Materials and methods

In vitro study

Tissue harvest and preparation

Preoperatively, 20 cc of heparinized blood (0.1 cc per 100 ml of blood) was obtained from the patient and centrifuged for 7 min at 3000 rpm (1200 G; Figure 2, left). The supernatant plasma was aspirated and stored in a 10-cc Luer lock syringe (Figure 2, right). Lipoaspirate (LA) material was obtained with informed patient consent through the Plastic and Reconstructive Surgery Unit at the University Hospital Gent (Ethics Committee number EC 2010/496). The fat was harvested using the Coleman technique from the thigh region. The donor sites were infiltrated with Klein solution using a blunt infiltrator. A 3-mm harvesting cannula was used, connected to a 10-cc Luer lock syringe, which was spun at 3000 rpm for 3 min (1200 G; Byron Medical Inc.,