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REGULAR ARTICLE

Activated omentum becomes rich in factors that promote healing and tissue regeneration

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Abstract In order to study the mechanism by which an omental pedicle promotes healing when applied to an injured site, we injected a foreign body into the abdominal cavity to activate the omentum. One week after the injection, we isolated the omentum and measured blood vessel density, blood content, growth and angiogenesis factors (VEGF and others), chemotactic factors (SDF-1α), and progenitor cells (CXCR-4, WT-1). We found that the native omentum, which consisted mostly of adipose tissue, expanded the mass of its non-adipose part (milky spots) 15– to 20-fold. VEGF and other growth factors increased by two– to four-fold, blood vessel density by three-fold, and blood content by two-fold. The activated omentum also showed increases in SDF-1α, CXCR-4, and WT-1 cells (factors and cells positively associated with tissue regeneration). Thus, we propose that an omentum activated by a foreign body (or by injury) greatly expands its milky-spot tissue and becomes rich in growth factors and progenitor cells that facilitate the healing and regeneration of injured tissue.

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Introduction

The omentum, a sheet-like tissue attached to the greater curvature of the stomach, has been referred to as an adipose tissue with islands of compact tissue containing immune cells called "milky spots" (Liebermann-Meffert 2000). Although its natural role is not clear, transposing the omental pedicle to injured organs (omental transposition) has been used for over 100 years to promote healing (Cannaday 1948; Vineberg et al. 1966). The omentum also provides a "safe haven" for sustaining transplanted pancreatic islets, expanding cultured hepatocytes, and growing embryonic kidney and pancreas anlagen into adult organs (Kin et al. 2003; Sigrist et al. 2003; Lee et al. 2003; Hammerman 2004; Rogers et al. 2003; Takashi et al. 2006).

More recently, Goldsmith's group has demonstrated that omental transposition promotes healing and even regeneration of neurons across a transected spinal cord in experiments in cats and also in one patient (Goldsmith and de la Torre 1992; de la Torre and Goldsmith 1994; Goldsmith et al. 2000, reviewed in Goldsmith 2004) resulting in the unexpected recovery of limb function. Despite reports of the benefits of omental transposition in acute injury, studies addressing the mechanism by which the omentum exerts such effects are lacking. However, in contrast to the functional recovery observed in cats in which omental transposition is performed hours after injury, the benefits of omental transposition in patients with long standing spinal injury remain questionable (Clifton et al. 1996; Duffill et al. 2001).

The omentum has the innate property of sensing injured sites in the abdominal cavity and of firmly adhering to