

Growth Factors	Effects
Platelet derived growth factor	Stimulates collagenase, fibronectin and hyaluronic acid synthesis
Transforming growth factor	Promotes angiogenesis and collagen production
Vascular endothelial growth factor	Promotes angiogenesis during tissue hypoxia
Epidermal growth factor	Stimulates keratinocytes and fibroblast proliferation
Fibroblast growth factor	Promotes angiogenesis, granulation and epithelialisation
Interleukins	Chemotactic for neutrophils and fibroblasts
Colony stimulating factor	Stimulates granulocyte and macrophage proliferation
Keratinocyte growth factor	Stimulates keratinocyte migration, differentiation and proliferation

Table 1. The most representative function of the main growth factors.

Growth Factor	Most representative function
Platelet-derived growth factor	Chemotaxis, inducing cells to migrate to the wound bed. ¹
Transforming growth factor- β	Cell proliferation inhibition, increase in synthesis of extracellular matrix and inhibition of its degradation; it favors neutrophil and monocyte chemotaxis, ⁶ although its specific action also depends on the cell environment.
Bone morphogenetic proteins	Repair of epidermis in more superficial layers of skin and inhibition of keratinocyte proliferation in deeper layers. ^{5,5}
Fibroblast growth factor	Mitogenic for endothelial cells, fibroblasts, chondroblasts, and osteoblasts ⁷ ; it favors angiogenesis.
Epidermal growth factor	Proliferation and mobility of fibroblasts and keratinocytes. ^{6,6}
Vascular endothelial growth factor	Angiogenesis and increase in capillary permeability. ^{6,7}
Insulin-like growth factor	Favoring reepithelization and production of granulation tissue. ³⁰
Interleukins	General proinflammatory function, regulation of immunological cell growth and/or differentiation. ^{6,8}

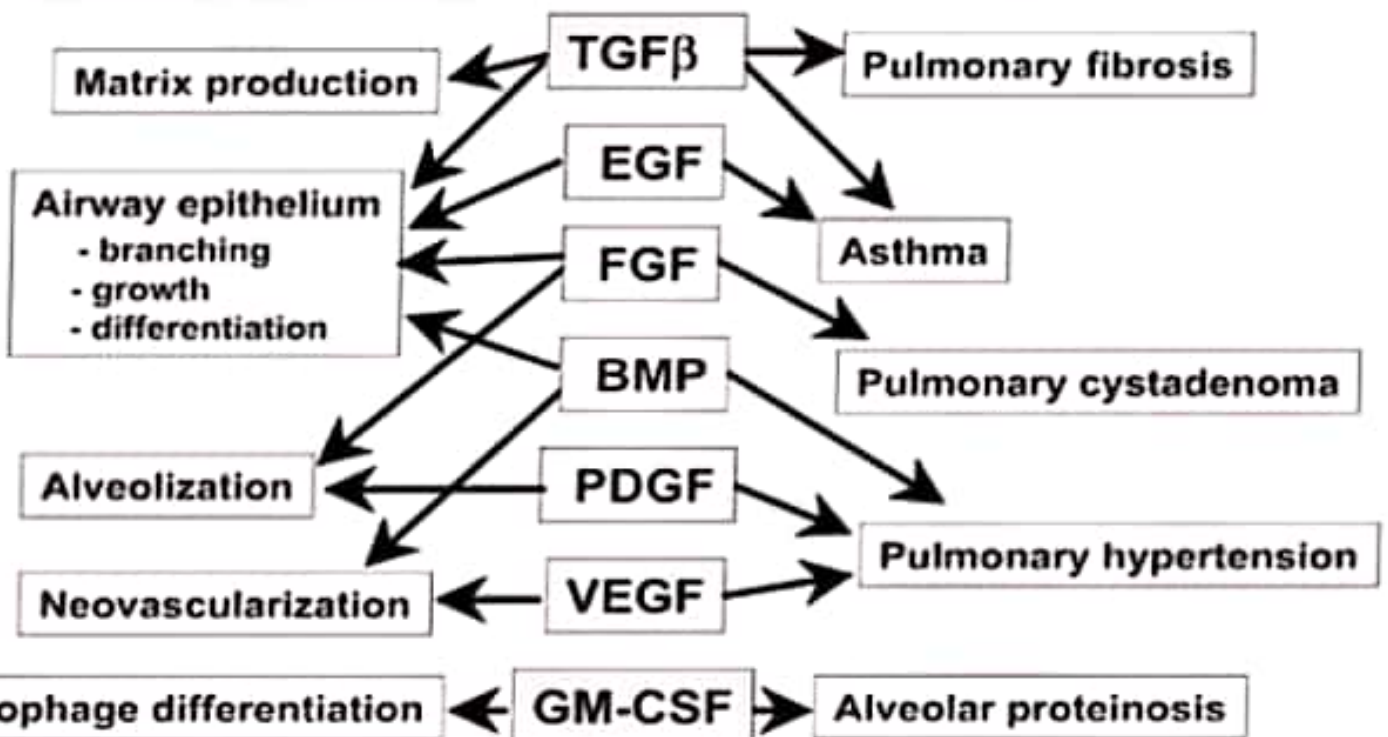
Growth Factors in Repair

- EGF: Epidermal Growth Factor enhances the proliferation of fibroblasts and endothelial cells.
- PDGF: Platelet-derived Growth Factor is produced by platelets, macrophages endothelial cells, and smooth muscle cells. It enhances the proliferation of fibroblasts and smooth muscle cells.
- FGF: Fibroblast Growth Factor enhances the proliferation and recruitment of macrophages and fibroblasts.

Growth factor or cytokine	Effect on wound	Current status
Transforming growth factor β	Re-epithelialisation Neovascularisation Increased granulation tissue and collagen Reduced scar formation	Initial studies in venous ulcers encouraging
Platelet derived growth factor	Re-epithelialisation Neovascularisation Increased granulation tissue and collagen	Licensed for the treatment of neuropathic diabetic foot ulcers
Fibroblast growth factor	Re-epithelialisation Neovascularisation of a provisional matrix	Biological effects in pressure ulcers No effect on diabetic or venous ulcers demonstrated to date
Interleukin 1 β	Healing of infected wounds	Currently under trial for pressure ulcers
Granulocyte macrophage-colony stimulating factor	Improved healing in acute wounds	Pilot studies in infected diabetic foot ulcers encouraging

DEVELOPMENT

DISEASE



Growth Factor	Function
Epidermal growth factor (EGF)	Stimulates growth of many epidermal and epithelial cells
Erythropoietin (EPO)	Regulates development of early erythropoietic cells
Fibroblast growth factors (FGFs)	Promote proliferation of many different cells
Interleukins	Interleukins exert a variety of effects on cells of the immune system
Nerve growth factor (NGF)	Trophic effect on certain neurons
Platelet-derived growth factor (PDGF)	Stimulates growth of mesenchymal and glial cells
Transforming growth factor-alpha (TGF α)	Similar to EGF
Transforming growth factor-beta (TGF β)	Exerts both stimulatory and inhibitory effects on certain cells

Many other growth factors have been identified. Growth factors may be made by a variety of cells, or may have mainly one source. Many different interleukins have now been isolated; along with the interferons and some other proteins/polypeptides, they are referred to as cytokines.