WOUND INTELLIGENCE
Continuing Education in Wound Management

WOUND HEALING AND GRANULATION: CLINICAL CONSIDERATIONS

Tal Ellis

Leading medical and health care company, Paul Hartmann Pty Ltd, invests considerable resources in clinical education and training on wound management for nurses around Australia. As part of its commitment, the Company has sponsored a series of articles, which take an in-depth look the stages of wound healing for the Australian Nursing Journal.

As part of the series, Tal Ellis, a lecturer from the University of South Australia School of Nursing, contributed this article on granulation, the second stage of wound healing.

Figure 1: Stages of Wound Healing

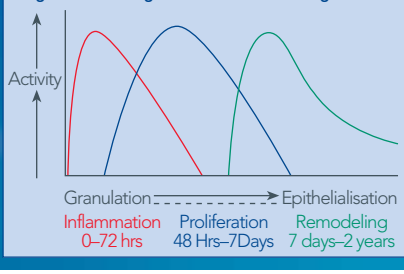

Figure 2: Granulation Tissue

"The proliferation stage is divided into three discreet processes: the formation of granulation tissue, epithelial migration and wound contracture"

Wound healing is a complicated process. In an acute wound there are several stages of healing that occur primarily in sequence, but overlap in their beginning and end (fig 1). These stages are inflammation, proliferation and remodeling. The same fundamental healing process also occurs in enduring, or 'chronic' wounds, but not in an orderly or timely fashion.

The proliferation stage is divided into three discreet processes: the formation of granulation tissue, epithelial migration and wound contracture. This article examines the development of granulation tissue in some detail.

Granulation tissue forms in the base of healing wounds and has a red, glassy, granular appearance, hence its name (fig 2). The appearance of granulation tissue is largely due to the growth of new blood vessels, known as angiogenesis, and the formation of an extracellular matrix occurring after the wound has been sufficiently cleansed during the inflammatory stage[1].

As the formation of granulation tissue is energy-dependent and operates across a hypoxic-oxygenated tissue continuum, there are a large number of factors that can influence its rate of development, appearance and health. Granulation tissue growth is considered a key indicator of healing and practitioners need to be well appraised of the necessary observation criteria in order to plot the healing cascade of a wound[2].

One of the primary events in the growth of granulation tissue is the formation of new blood vessels. Wound space is typically hypoxic and exhibits tissue oxygen concentrations of less than 30mmHg[3]. Under these hypoxic conditions macrophages (modified monocytes) secrete growth factors and cytokines that stimulate the production of a jelly-like ground substance (glycosaminoglycans) by fibroblasts[4].

Blood vessel forming cells, known as endothelial cells, migrate into this matrix and the stimulating factors from macrophages cause these endothelial cells to divide and begin forming rudimentary capillaries then capillary loops. When these loops are continuous with remnant capillaries, red blood cells begin to infiltrate the wound space and increase the oxygen tension[5]. Once the levels of oxygen rise above 20mmHg collagen precursors can be excreted by the fibroblasts and once oxygen tension above 40mmHg is achieved, cross-linking of the collagen can begin[6]. At this point the newly formed granulation tissue is very delicate, bleeds if traumatised and develops the red-glass like characteristics.

When observing granulation tissue, the practitioner should look for a stable, moist tissue bed filling the wound space. The treatment aim is to support the growth and formation of granulation tissue by maintaining the correct moisture balance at the wound-dressing interface and reducing disturbances like dressing changes to an absolute minimum. Correct wound bed management at this time will ensure that the wound heals in a timely and functional manner.

References: 1,2. Flannagan, M (1998) Journal of Wound Care, vol 7, no 10, p 508 – 510. **4**. Silver, I A (1994) Journal of Wound Care, vol 3, no 2, p 106 – 109. **3,6**. Gottrup, F (1995) Primary Intention, vol 3, no 1, p 4-8 **5**. Gill, D (1998) Journal of Wound Care, vol 7, no 8, p 411 – 414.

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