

Pain and stress as contributors to delayed wound healing

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Abstract

It is possible that patients who suffer from acute and chronic wounds can interpret wound pain as a stressor. It is known from previous research that stress can delay wound healing; however, little is known about the influence of pain in this relationship. This review explores the literature surrounding the relationship between stress, pain and delayed healing of acute and chronic wounds. Many studies have demonstrated the impact of stress on the healing of biopsy, surgical and chronic wounds and there is a range of medical, psychological and social interventions that may reduce both pain and stress and consequently speed up wound healing.

Keywords: Pain, stress, wound healing, management, assessment.

Introduction

The International Association for the Study of Pain (IASP)¹ defines pain as a sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage. It has been suggested that wound-related pain can have a negative impact on wound healing, which can adversely affect patient quality of life (QoL)². A patient's perception of pain can be influenced by psychological, emotional, cognitive and social factors, as well as learned behaviours³. These might include: the influence of a patient's previous experience of painful and stressful events; the individual differences in strategies adopted by patients for coping with pain; negative social comparisons with other patients at different stages of recovery; and poor mobility or activity levels, to name but a few.

Blythe *et al.*⁴ estimated that the prevalence of chronic pain in Australia was approximately 37% amongst males and females and there is considerable research evidence that has led to guidance relevant to pain assessment and management. Overall, it is clear that pain is not only a physiological

symptom, as it can be interpreted by patients in many different ways. Pain itself can be better described as a biopsychosocial concept that can be viewed by the patient as a stressor.

In the field of wound care, pain can result from the wound itself and can also be caused by some wound treatments. It has been suggested that dressing removal, wound cleansing, debridement and inappropriate dressing selection can contribute to wound-related pain⁵. It is known that patients with wounds can experience nociceptive pain (a persistent ache) as a result of tissue damage and neuroceptive pain (a stinging or stabbing pain) as a result of nerve damage⁶. A recent multinational survey of the assessment of pain at dressing change revealed that the use of dressings specifically designed to minimise trauma and pain were beneficial to patients⁷. The assessment and management of wound pain is important in gaining trust from patients, as pain can lead to increased stress, which has been shown to contribute to a delay in wound healing⁷. As well as this, the correct selection of wound dressings could contribute considerably to the improvement of pain, stress and patient QoL⁸.

Stress most commonly refers to the consequences of the failure of the human body to respond appropriately to physical or emotional threats⁹. Stress is a highly subjective experience that can affect patients in many different ways. For example, some patients may perceive wound treatments as stressful events, whereas other patients may not. Psychologically, it is known that stress can increase the probability of patients making negative cognitive appraisals. For example, patients who perceive a dressing removal to be an unpleasant and stressful event can experience poor coping strategies and avoidance of treatment, which can be harmful to the wound healing process. In addition to this, stress is known to have a physiological impact, as it may lead to raised levels of the hormone cortisol¹⁰. As a consequence, continued raised levels

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of cortisol can lead to increased heart rate and blood pressure, and can negatively impact on immunity and inflammatory bodily function. If the immune system is suppressed, then this can have a negative impact on wound repair. For example, a reduction in the level of proinflammatory cytokines and enzymes involved in tissue repair will create a delay in the healing process. If immune suppression is prolonged, it may also create an opposite effect, in which the immune system elicits an excessive response and attacks its own body¹¹, which is also detrimental to the healing process. It is, therefore, logical to assume that pain-induced stress can reduce the rate of wound healing¹².

Impact of pain on wound healing

Chronic wound pain has been related to poor adaptation to living with a wound, for example depression and low self-esteem¹³. Patients who suffer from wound pain can experience worries and frustrations about the wound and reduced self-esteem, which can have a negative impact on psychological functioning¹⁴. Wounds can cause patients severe emotional and physical stress as well as creating a significant financial burden on patients and the whole healthcare system³. Both patients and wound care professionals understand that pain is an accepted feature of wounds¹⁵; however, this needs to be taken into account during wound care to prevent distress to the patient, which may result in delayed healing.

The relationship between pain and stress is complex. It is known that pain can contribute to stress and other negative emotional states such as anxiety, fear and depression¹⁶. It has been suggested that anxiety leading to stress can decrease one's pain threshold, reduce pain tolerance and impact the immune system. Wound healing can be delayed as a consequence of this.

The aim of this review is to investigate the relationship between stress, pain and wound healing and to identify both psychological and physiological methods for assessing and managing stress and pain. By implementing such methods in clinical practice, clinicians would be provided with information of patients' individual treatment needs, which could improve healing rates.

Literature search strategy

This review identified studies using a number of electronic databases including PubMed, British Nursing Index (BNI), Cumulative Index to Nursing and Allied Health Literature (CINAHL), Academic Search Complete and PsycINFO. The literature search covered the period from 1988 to 2009. A follow-up search of references from articles already obtained was conducted to identify additional relevant studies.

The following terms were searched both separately and in varying combinations as keywords anywhere in the article

including: wound healing; psychological; physiological; stress; delayed healing; acute; chronic; wounds; pain; management; assessment.

Studies were included in the review according to the following criteria: the use of stress and pain measures; inclusion of male and/or female participants; patients with biopsy, acute, surgical or chronic wounds; review articles of the relationship between stress and wound healing; publication in English-language, peer-reviewed journals.

Studies were excluded from the review if they involved the use of animal subjects; used a case study design; or were review articles of specific dressings.

The relationship between stress, pain and wound healing

Psychologically, stress is a highly subjective experience that patients can perceive and experience in many different ways. A study by Clarke¹⁷ indicated that patients associated 'stress' with approximately 2,000 different terms and concepts, which demonstrates that stress can be perceived in different ways by different individuals. For example, some patients may perceive certain wound treatments as stressful events, whereas other patients may not. In addition to this, stress can increase the probability of patients making negative cognitive appraisals, for example, perceiving a dressing removal as an unpleasant experience can lead to poor coping and avoidance of treatment, which can be harmful to the wound healing process. Patients can interpret pain and stress in different ways; therefore, it is possible for patients to experience one without the other (Figure 1).

Many studies have been conducted to investigate the relationship between stress and wound healing. Most of the evidence has been obtained from studies of participants with experimentally induced wounds (biopsy wounds) and from patients with acute and surgical wounds.

Kiecolt-Glaser *et al.*¹⁸ investigated the impact of hostile marital interactions on proinflammatory cytokine production and the healing of experimentally induced blister wounds. Wound fluid was collected at four, seven and 22 hours after wounds had been administered and blood samples were obtained on the morning of wounding. Participants also completed the Rapid Marital Interaction Coding System, to determine high and low hostile behaviours. As part of the study, participants attended two discussions, a social support discussion and a conflict interview. Findings revealed that blister wound healing was slower following conflict interviews than after social support discussions. Moreover, participants who were categorised as high hostile, experienced slower wound healing after both discussions, in comparison with participants who were categorised as low hostile.

Similar findings were obtained from a study investigating the impact of anger expression and low anger control on punch biopsy wound healing¹⁹. Participants who were found to exhibit lower levels of anger control were more likely to be categorised as slow healers. In addition to this, participants with lower levels of anger control displayed higher cortisol reactivity during administration of the punch biopsy wound, which was related to slower wound healing.

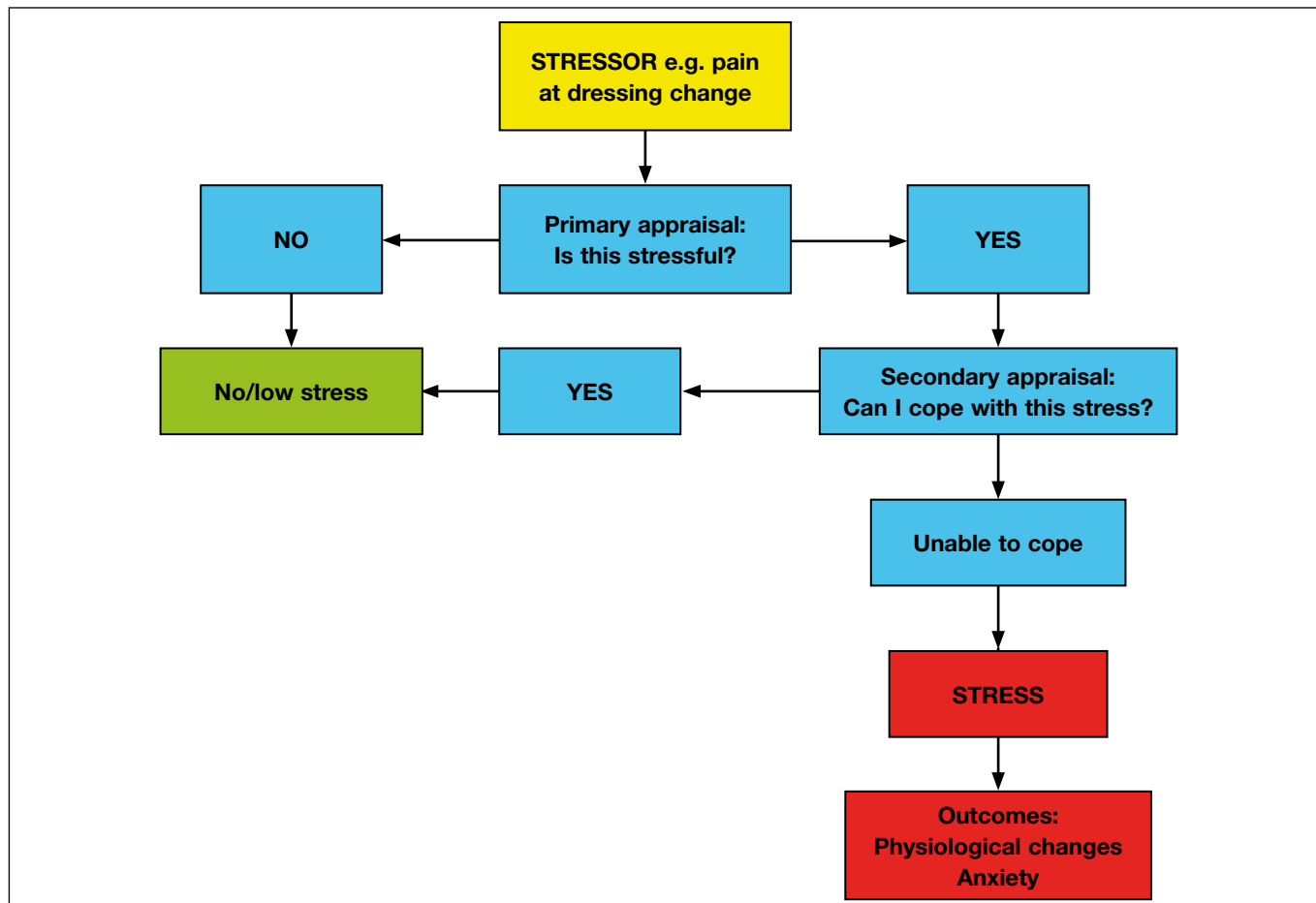
Ebrecht *et al.*¹⁰ reported on the relationship between perceived stress and delayed wound healing. Punch biopsy wounds were administered and participants were required to complete questionnaires on perceived stress (Perceived Stress Scale, PSS) and health behaviours (General Health Questionnaire, GHQ-12)^{20,21}. Saliva samples for cortisol assessment were also obtained from participants after awakening and at two weeks before, directly after and two weeks after the punch biopsy was administered. Findings included a significant negative relationship between healing speed and both the PSS ($r=-0.59$; $p<0.01$) and GHQ-12 ($r=0.59$; $p<0.01$) scores, at the time of wound administration. It was also found that cortisol levels increased on the morning after wound administration and this was associated with slower wound healing ($r=-0.55$; $p<0.05$). No associations were found between healing speed

and health behaviours (including alcohol consumption, exercise, healthy eating and sleep influences), which suggests that perceived stress has an impact on wound healing, with increased cortisol levels playing a role in this effect as opposed to health behaviours.

In line with other findings, Holden-Lund²² conducted a study to investigate the effects of an audiotape series implementing Relaxation with Guided Imagery (RGI) on surgical wound healing. The audiotapes were designed to put the patients in a relaxed but focused state. Patients were assigned to either an RGI group or a control group, who experienced quiet periods. Overall, patients in the RGI group exhibited significantly less state anxiety, lower cortisol levels and less surgical wound erythema than the control group. These findings suggest that the RGI tapes brought about a reduction in stress, which was associated with faster healing. This study, in particular, would suggest that the use of stress management interventions would be beneficial in clinical practice, to facilitate the wound healing process.

In order to promote wound healing, it has been suggested that social support can be an effective stress management intervention. Edwards *et al.*²³ investigated the impact of a

Figure 1. A flow chart diagram to show how patients may interpret pain as a stressor.



community-based Leg Club environment on healing rates of venous leg ulcers compared to a control group of patients receiving treatment in their own homes, as measured by ulcer area size and Pressure Ulcer Scale for Healing. It was found that the community Leg Club environment provided support and encouraged information sharing in addition to wound treatment and standard evidence-based care, which had a beneficial impact upon wound healing.

However, very few studies exist that specifically demonstrate the complex relationship between stress and the healing of chronic wounds, which is an important focus for future research. Further still, studies that demonstrate the role of pain in this relationship are limited.

Measuring stress and pain in wound care

It is suggested that measures of pain and stress are implemented routinely during the wound care process. Implementation of assessment tools could result in an increased awareness in both pain and stress, which should enable a better focus on such patient factors and thereby influence the rate of healing.

Patient-centred assessments are important during the wound care process as they can provide sensitive and effective management of wound pain²⁴. Wound care professionals should acknowledge individual patient behaviours (both verbal and non-verbal) as this can indicate signs of pain and stress. For example, Feldt²⁵ outlined a checklist of non-verbal pain indicators (Table 1). Similarly, patients can also display behavioural signs of stress, which wound care professionals should acknowledge during the wound care process (Table 2).

Stress assessment tools

There are several methods that wound care professionals can use to assess patients' stress levels during wound care. Some of these measurements are likely to be considered as part of routine practice and can be used to identify physiological symptoms of stress, including:

- Accelerated heart rate.
- Increased blood pressure.
- Rapid respiration rate.
- Increased galvanic skin response (GSR).
- Production of the 'stress hormone' cortisol.

However, physiological assessments should be accompanied by other stress measurement tools to eliminate alternative causes of increased physiological symptoms; for example, elevated heart rate or blood pressure could be due to any number of factors and not just stress.

Effective psychological measures of stress can be used in addition to physiological measures, which focus on emotional responses obtained through self-report methods.

Table 1. Checklist of non-verbal pain indicators²³.

- **Vocal expressions:**
moans, grunts, cries, sighs, gasps.
- **Facial expressions:**
winces, grimace, furrowed brow, tightened lips, jaw drop, clenched teeth.
- **Bracing:**
clutching/holding bed rails, tray or table, or affected area of pain.
- **Restlessness:**
shifting position, hand movements, unable to keep still.
- **Rubbing:**
touching, holding, rubbing or massaging affected area.

Table 2. Behavioural signs of stress.

- Rapid breathing rate.
- Faster eye-blink rate.
- Increased heart rate.
- Muscle tension.
- Squirming, sweating palms.
- Dry mouth, tense voice.
- Pale skin, cold sweat.
- Avoidance behaviour.

An advantage of psychological measures is that they allow patients to become involved in their own wound care. The following questionnaires may be suitable to administer as part of the wound care process:

The Hospital Anxiety and Depression Scale (HADS)²⁶ is designed for use in medical out-patient settings, to detect and assess clinical cases of anxiety and depression. The HADS comprises 14 items, which would take each patient a short amount of time to complete. Higher scores obtained on this scale indicate greater anxiety or depression. An advantage of this measure is that it can be administered at intervals (such as during and after a dressing change) to determine any differences in scores over time.

The Perceived Stress Scale (PSS)²⁰ is designed to measure the degree to which patients perceive situations in their life to be stressful. Higher scores obtained on this questionnaire indicate more perceived stress. A particular advantage of this measure is that it is more focused on the patient's appraisal of stressful events, as opposed to the number of stressful events experienced. However, the items in this questionnaire refer to the occurrence of thoughts and feelings the patient

has experienced in the last month. Therefore this is a more general measure of stress, rather than stress specific to a particular clinical situation (for example, a dressing change).

The State Trait Anxiety Inventory (STAI)²⁷ is designed to clearly differentiate between a patient's temporary condition of state anxiety and the longer term experience of trait anxiety. In contrast to the PSS, the STAI will measure anxiety specific to a situation (for example, a dressing change), which would be beneficial when carrying out wound assessments.

The General Health Questionnaire (GHQ)²¹ is designed to identify and measure emotional distress in patients situated in both community and clinical settings. Higher scores obtained on the GHQ indicate greater emotional distress. An advantage of this measure is that the items allow for the assessment of anxiety, insomnia and depression without focusing on physical symptoms of illness. In addition, the items are also designed to determine patients' health behaviours. Although the items are not specifically designed to measure stress, the GHQ could be used in practice to provide information on health behaviours to accompany other measures of stress.

Pain assessment tools

Similarly, there are a number of self-report measures that can be implemented during wound care to assess pain. As pain is known to contribute to stress, assessment of pain is important for wound care professionals to be able to understand the level of pain patients are experiencing during wound care.

Measures of pain often include an index or scale to determine the amount of pain that patients are experiencing. The following assessment tools would be beneficial to administer as part of the wound care process:

The McGill Pain Questionnaire (MPQ)²⁸ is a multidimensional assessment tool that is designed to determine different components of reported pain, such as the location and description of pain. It also measures how a patient's pain changes over time and can identify the factors that relieve or increase it. In addition to this, the MPQ includes a measure of pain intensity. An advantage of the MPQ is that it is sensitive to changes in treatment, which would enable clinicians to compare a patient's pain in specific situations over time. Furthermore, it can provide information on the effects of a specific treatment (for example, a dressing change) on the sensory, affective and evaluative dimensions of pain.

Verbal Pain Rating Scale (VPRS)/Numerical Pain Rating Scale (NPRS)

These scales require the patient to define their pain either from a list of describing words, for example mild, discomforting, horrible, excruciating; or in numerical terms, for example 0 (no pain) to 100 (severe pain). An advantage of these scales is that they can be implemented to assess pain intensity at

intervals, over time. However, patients may be able to recall previous ratings when completing the scale, which could influence their current ratings.

To overcome this, the **Visual Analogue Scale (VAS)** could be administered, in which patients are required to draw a cross on an unmarked line with extreme pain descriptors at each end, to determine their current pain intensity. Unlike the VPRS and NPRS, patients are less likely to be able to recall the location of the cross they previously drew on the scale. Therefore the effects of practice bias on their rating of current pain intensity would be reduced.

Implementation of both stress and pain assessment tools will enable wound care professionals to administer appropriate methods of pain relief, which could contribute to a subsequent reduction in stress. In addition to this, wound care professionals should select the most appropriate dressings for patients, which would facilitate a reduction in pain at dressing change. It has been demonstrated that soft silicone adhesive dressings can significantly decrease pain at dressing change, as opposed to traditional adhesive-based dressings⁷. With regard to this; the World Union of Wound Healing Societies (WUWHS) identified the effects of different dressing adhesives on wounds and their potential to reduce pain at dressing changes (Table 3).

Discussion

Evidence to suggest that stress can delay wound healing is increasing. Furthermore, it has been demonstrated in many studies that stress can impact wound healing in both psychological and physiological ways. For example, studies that demonstrate the use of stress management interventions such as relaxation techniques and emotional disclosure interventions, show improved wound healing rates in comparison with control groups. Furthermore, that stress experienced during surgical wound healing can contribute to lower levels of proinflammatory cytokines in wound fluid following surgery. Therefore, in clinical practice it should be considered important to manage patients' stress during wound healing process.

Overall, the majority of the evidence for this relationship comes from studies of acute wound healing. So these findings cannot necessarily be attributed to the healing of chronic wounds as evidence of the mechanistic underpinnings of the relationship between stress and chronic wound healing is limited.

From the evidence presented in this review it is suggested that appropriate assessment of stress and pain should be implemented routinely during wound care, as this will accommodate patients with the most effective treatment based upon their individual needs. When measuring levels of stress and pain, the use of both psychological and

Table 3. The impact of different dressing types on wound-related procedures (adapted from WUWHs²⁷).

Dressing types	Application	Removal
Acrylates/Polyurethanes	+ Strong bond to skin. – Can cause allergies.	– Increased occurrence of pain and trauma. – Can leave residue on the skin.
Hydrocolloids	+ Local warmth promotes bond to the skin surface. – Edges may roll. – Adhesive may dissolve in the presence of exudate.	– Can leave residue on the skin. – Increased occurrence of pain and trauma.
Soft silicone	+ Good adherence to the skin, without strong bonding. + Sticks instantly to the skin.	+ Minimal trauma and pain at dressing changes. + Easy to check wound and reapply.
Non-adhesive alternatives (e.g. pastes, non-adherent foams)	– Can be difficult to fix to the skin. – Susceptible to local friction and shear. – Selection dependent on exudate level.	– Can cause local trauma, maceration or drying if moisture balance is not maintained.

physiological measures would allow clinicians to monitor any physiological changes associated with stress and pain, as well as involving the patients' feedback on their perception of stress and pain.

It has also been suggested in the literature that the role of social support is advantageous in reducing psychological stress during wound healing and that the impact of interventions such as the Leg Club environments should be further investigated as they have been shown to improve healing rates in addition to medical treatment.

However, research that specifically looks at the impact of pain on wound healing is limited. Future research should, therefore, focus on this relationship and, in addition, on potential interventions that could be administered to reduce pain and stress to improve healing of both acute and chronic wounds.

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