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It's Not Just a Burn

Physical and Psychological Problems after Burns

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Abstract

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Survival after severe burns has improved in recent decades, but there is limited information on the course of recovery after surviving a burn and on factors that can affect recovery.

The aims of this thesis were to investigate the occurrence of physical and psychological problems after burns, and to examine the consequences of psychological problems for the clinical management of burn patients.

Three groups of consecutive patients who were treated at the Burn Unit at Uppsala University Hospital between 1980 and 2005 were included in the studies. The Burn Specific Health Scale (BSHS) was used for self-report of burn-specific aspects of health. Personality traits and coping strategies as psychological factors during recovery were examined with the Swedish universities Scales of Personality (SSP) and the Coping with Burns Questionnaire (CBQ). Presence of symptoms of posttraumatic stress were assessed with the Impact of Event Scale-Revised (IES-R), and the Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-I) was used to determine the concurrent validity of the IES-R as a measure of Posttraumatic Stress Disorder (PTSD). Furthermore, the effect of pre-injury psychiatric morbidity on perceived health one year after injury was assessed.

Both pruritus and nightmares were common problems after burns; 59% of the individuals in the study reported pruritus and 43% reported nightmares. Neuroticism-related personality traits and avoidant coping strategies were associated with an increased risk of having pruritus or nightmares. The presence of nightmares could be used as a screening tool for high scores in the IES-R. The IES-R was in turn shown to be a good, although overly inclusive, test for the diagnosis of PTSD. Pre-injury psychiatric morbidity predicted perceived outcome in six out of nine burn-specific health domains.

These studies show that psychological factors and psychiatric morbidity affect outcome after burns.

Keywords: Burns, Injury, Trauma, Health Status, Rehabilitation, Outcome Assessment, Personality, Coping, Depression, Posttraumatic Stress Disorder, Impact of Event Scale, Nightmares, Pruritus, Itch, Skin, Psychiatric Disorders

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“The fire is a watershed,
a change in the direction and meaning of your life.”

From Changing Faces by James Partridge

List of publications

This thesis is based on the following papers, which are referred to in the text by their Roman numerals:

- I Willebrand M, Low A, Dyster-Aas J, Kildal M, Andersson G, Ekselius L, Gerdin B. Pruritus, personality traits and coping in long-term follow-up of burn-injured patients. *Acta Dermato-Venereologica*. 2004;84:375-80.
- II Low JFA, Dyster-Aas J, Willebrand M, Kildal M, Gerdin B, Ekselius L. Chronic Nightmares After Severe Burns: Risk Factors and Implications for Treatment. *J Burn Care Rehabil*. 2003;24:260-7
- III Low AJF, Dyster-Aas J, Kildal M, Ekselius L, Gerdin B, Willebrand M. The Presence of Nightmares as a Screening Tool for PTSD Symptoms in Burn Survivors. *J Burn Care Res*. 2006;27:727-33
- IV Low JFA, Willebrand M, Dyster-Aas J, Ekselius L, Gerdin B. A Validation of the Swedish Version of the Impact of Event Scale-Revised (IES-R) in Burn Patients. Manuscript.
- V Low JFA, Dyster-Aas J, Willebrand M, Ekselius L, Gerdin B. Psychiatric morbidity predicts bad burn specific outcome one year after a burn. Manuscript

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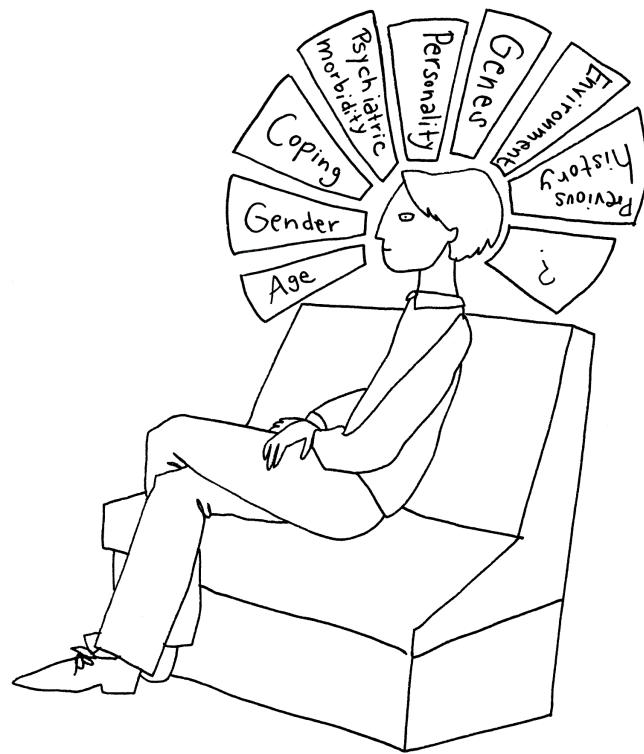
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Abbreviations

BSHS	Burn Specific Health Scale
BSHS-B	Burn Specific Health Scale-Brief
CAPS	Clinician Administered PTSD-Scale
CBQ	Coping with Burns Questionnaire
DA	Discriminant Ability
DALY	Disability-Adjusted Life Year
DSM-III	Diagnostic and Statistical Manual of Mental Disorders 3 rd version
DSM-IV	Diagnostic and Statistical Manual of Mental Disorders 4 th version
ICSD-R	International Classification of Sleep Disorders
IES	Impact of Event Scale
IES-R	Impact of Event Scale-Revised
KSP	Karolinska Scales of Personality
LOS	Length of Stay
LR	Likelihood Ratio
LR+	Likelihood Ratio of a positive test result
LR-	Likelihood Ratio of a negative test result
NEO PI	Neuroticism Extraversion Openness Personality Inventory
PTSD	Post Traumatic Stress Disorder
REM	Rapid Eye Movement
SCID-I	Structured Clinical Interview for DSM-IV Axis I psychiatric disorders
SD	Standard Deviation
SSP	Swedish universities Scales of Personality
TBSA	Total Body Surface Area
TBSA-FT	Total Body Surface Area of the Full Thickness Burn



Introduction

Why would a plastic surgeon write a doctoral thesis on psychological problems after burns?

Is it strange for a plastic surgeon to be involved in psychosocial research?

In the 16th century Paracelsus criticised the separation between medicine and surgery and wrote: “How can ye establish it as another faculty and profession? Ye wood doctor and fool!... In judicando ye are a physician, in curando a surgeon. The patient asks for cure – surgery – and not for theory – medicine – it is the doctor who needs the latter. That is: there can be no surgeon who is not also a physician; the latter begets the surgeon and the surgeon tests the physician by the result of his work.” [17].

The treatment of burns is a long procedure that begins on the day of injury and can continue for many years or even decades. Initially, the focus is on the wounds, and surgery in its real meaning (handicraft) is one of the main components of treatment. But even at this early stage other elements affect recovery; on daily ward rounds many patients describe problems with nightmares and itching of the newly healed skin and scars. They feel tired and frustrated because itching or nightmares have interrupted their sleep, resulting in a lack of tolerance and motivation to comply with the strenuous and often painful rehabilitation.

For me, the first question was therefore, How many patients have these problems and why do they have them? And further questions were, What are the risk factors? Is it just the burn, or are there other factors, and if so, what are they? What consequences do they have for treatment?

The general impression from daily work on the Burn Unit is also that burns seldom “just happen”; predisposing factors for injury can often be found in the patient’s history, including social problems, substance abuse, or mental illness. Furthermore, these factors appear to affect recovery.

That first question about nightmares started a long journey into the “machinery” behind recovery; as pointed out by Paracelsus, in order to do my best as a surgeon I needed to acquire knowledge about the underlying theory.

Burns and their treatment

A burn is the partial or complete destruction of the skin by thermal energy from flames, steam and hot liquids, contact with hot objects, explosion, or electrical current. Injuries to airways or other organs caused by the same mechanisms, and destruction of skin by chemicals or radiation, are also defined as burns.

A burn can be a devastating event in many respects [46, 136], and burns are often described as the greatest trauma an individual can sustain. In addition, the incident often has social consequences such as the loss of family members or friends as well as property and housing. The long hospitalisation required for treatment is not only a source of additional stress but can also lead to social isolation, financial problems and the loss of employment. Even with optimal treatment, scarring is inevitable with deep burns [84], and burn patients can lose body appendages, with the result that their appearance and physical function will be affected. Furthermore, to enable the burn survivor to attain an acceptable level of functioning, treatment and rehabilitation often continue for many years after injury [141].

Burns are one of the leading causes of death and disability worldwide [86, 144]. According to the World Health Organization, 238 000 individuals died of fire-related burns in 2000 [146], and 95% of these deaths occurred in low- and middle-income countries. Children and the elderly (over the age of 70) have the highest rates of mortality. Half of all fire-related deaths and half of all years lived with disability (DALY) occur in South-East Asia, and in this region a much higher proportion of the victims are females.

No information is available on the true incidence of burns in low- and middle-income countries, but it appears that the incidence is much higher than in high-income countries [85]. In Sweden the incidence of accidents is around 1 300 per 100 000 inhabitants, and 1.2% (16 per 100 000) of these are burns [132], which is a relatively low figure, even when compared to other high-income countries. Reasons for this low incidence may be well developed prevention measures and social health care as well as a fairly even economic standard throughout Swedish society.

Burns mostly cause minor injuries, and scalds are one of the most frequent mechanisms. Although house fires and ignition of clothing are less frequent, they have the highest mortality [144]. According to the World Health Organization [144] children and women sustain burns mainly at home or due to interpersonal violence, whereas men more frequently sustain work-related burns. Low socio-economic status, medical problems, alcohol and smoking are risk factors for burns [144].

Burns are described not only by their mechanism but also by their size, which includes the affected percentage of the total body surface area as well as the depth of the injury (see below).

Up until the 1960s only small burns were treated surgically using excision and closure, either by suturing the wounds or by coverage with small skin grafts [84]. It was during the 1960s that the combination of introduction of critical care medicine, antibiotic therapy, topical wound therapy and new surgical techniques, such as the use of dermatomes and skin meshing, enabled the early surgical treatment of larger burns. In this approach the burned tissue is removed before the wound can become infected, and the clean wound is then immediately covered with skin taken from uninjured body areas. In large burns, where the donor sites do not supply enough skin to cover all wounds in one operation, the un-grafted wounds are protected from infection either by skin substitutes or topical antimicrobial agents until the donor sites are healed and skin can be harvested again. This method reduces the risk for wound infections and sepsis, and has improved survival after burns [84, 113].

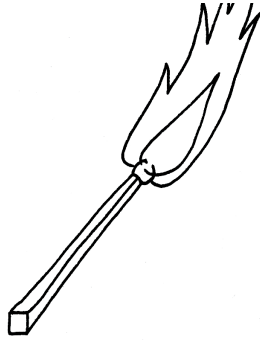
The goal for optimal burn care is to keep the average length of hospital stay below a ratio of one day per percent burned body surface area [98]. Although this implies a short length of hospitalisation in smaller burns, it also means that with optimal treatment the length of stay for a patient with a burn of 60% body surface will be two months. During this time the patient will undergo at least one operation, followed by other painful procedures such as mobilisation, physiotherapy, and dressing changes. This phase can be as traumatic as the actual injury [46].

Advances in surgery and critical care have improved survival following large burns. Whereas a person with a burn of 40% of body surface area had a 50% chance of survival in the early 1970s [141], this survival rate now applies to an individual with a burn of about 80% of body surface area. All the same, survival following a major burn is only the first step in a long process of returning to life. Future goals should be to ensure patient satisfaction with outcome and life after the injury, and to ensure that survival also includes reintegration and a return to the life the individual wants to live.

More knowledge is needed concerning the long-term outcome after burns, and the risk factors for problems during recovery and rehabilitation.

Some of the new questions that need to be addressed are:

- What is the frequency of specific problems?
- What is the cause of those problems?
- Do all burn survivors develop the same problems? If not, who will have problems?
- What can be done to avoid, recognise and treat these problems?



The skin

Function

The skin is the body's largest organ and it is also the largest interface with the surrounding environment. It has many functions [53]; it is a barrier and it protects the body from a multitude of threats from foreign organisms and changes in humidity and temperature in the surroundings. The skin also has an essential sensory function; it enables us to make contact with our surroundings and other humans by conveying sensations such as pressure, textures, and temperatures. The very basic character of this function is reflected in the positive effect of skin-to-skin contact on low birthweight newborns [25]. Furthermore, the skin fulfils a social, communicative function; it defines our appearance and reflects emotional reactions such as blushing and blanching, and the appearance and symmetry of facial skin have been shown to be determinants of attractiveness [61]. The face is also the basis for the first impression of a person's personality. A recent study showed that observers exposed to neutral facial expressions nevertheless made a judgment as to whether or not an individual was threatening after seeing the individual's image for less than one second [9].

Skin anatomy and the burned skin

The skin is divided into three layers, of which the epidermis is the outermost [53]. The epidermis consists of a stratified squamous epithelium, which is anchored upon a basement membrane, and of which the superficial layers are sequentially sloughed off and replaced. The epithelial cells, keratinocytes, produce keratin which forms the outer skin barrier that makes the skin waterproof and protects the deeper layers of the skin. Other cells in the epidermis are the melanocytes, which produce the skin's pigment melanin, Merkel cells, which are thought to be pressure receptors, and Langerhans' cells, which are antigen presenting dendritic cells in the first line of the body's immune defence. The so-called adnexa of the skin, i.e. hair follicles, sweat and sebaceous glands, are of epidermal origin, although anatomically they are projections of the epidermis into the dermis. They are of considerable importance in the treatment of burns, as the stem cell population from which skin regeneration occurs is predominantly located in the bulge region of the hair follicles [76].

The epidermis is firmly attached to the next layer, the dermis, by a basal membrane. The dermis mainly consists of connective tissue and its predominant components are collagen and elastic fibres, produced by connective

tissue fibroblasts. The function of the dermis is above all mechanical; it gives the skin its strength, durability and elasticity. A number of different cell types are embedded in the dermis, or pass through the dermis. The superficial part of the dermis has a relatively dense capillary bed, which has a key function in temperature regulation. A multitude of immune cells are mainly located around these superficial vessels. Afferent as well as efferent nerves transverse the dermis. Pain and itch are transmitted by free nerve endings of unmyelinated nerves in the superficial dermis, and special sensory bodies in the superficial dermis also transmit the sensation of pressure.

The third skin layer is the subcutaneous tissue, which connects the skin to the underlying structures and has a role in giving the skin its flexibility and elasticity as well as in defining the body's contours. The subcutaneous tissue does not have any cutaneous regenerative ability.

The depth of a burn is described in relation to the anatomical layer that is irreversibly damaged. Epidermal burns (1st degree burns) are limited to the epidermis. The skin may "peel" after about a week, which represents the sloughing of the damaged epidermal cells.

Superficial partial thickness burns (superficial 2nd degree burns) are limited to the upper layers of the dermis. The circulation and the sensory nerves of the skin are intact, making these injuries extremely painful. As the stem cell pool of the deeper parts of dermis also is intact, these burns heal within about two weeks and usually no scarring occurs, but the healed skin can itch for some time after injury.

Deep partial thickness burns (deep 2nd degree burns) involve most of the dermis. As these injuries can affect almost the entire dermis, the sensory nerve endings in this layer of the skin are damaged and these burns are therefore characterised by a loss of sensation in the burned area. The hair follicle stem cell pool is also affected, so that repopulation of the damaged area by keratinocytes either does not occur, or it occurs at a very slow rate and is then accompanied by scarring and wound contracture. To decrease healing time and the risk of severe wound contractures, skin is grafted to the wound bed and the healed skin will therefore have fewer or no skin appendages and fewer nerve endings, depending on the depth of the burn and the thickness of the skin grafts. If parts of the dermis are undamaged and can be preserved during treatment, the grafted deep dermal burn will retain some degree of elasticity and flexibility. Nerve regeneration after deep dermal burns has been discussed as a factor in the development of itching during healing of the skin, as well as during development of hypertrophic scars [4, 117].

Full thickness burns (3rd degree burns) destroy the entire dermis and the underlying subcutaneous tissue, and these injuries therefore require grafting. The extent of damage to the subcutaneous tissue has a considerable impact on the final appearance. If all subcutaneous tissue is lost, the skin grafts are placed directly onto the underlying muscle fascia. This causes an altered body contour and a loss of skin flexibility, as the healed skin will adhere

directly to the muscle and follow its movements. Furthermore, as in deep dermal burns, the grafted, healed skin will have fewer or no skin appendages and sensory nerve endings.

In both deep dermal and full-thickness burns, wound healing will always be accompanied by scarring and a tendency to contract. The scars are usually red and raised for at least six months, until the scar matures. The redness disappears and the scar becomes softer and flatter [78].

Pre-injury status and psychopathology

Previous investigations suggest that adaptation and adjustment after burns is not only influenced by burn size and depth, but also by gender, the individual's personality, strategies for coping with the event and socio-economic situation, and the presence of scars [69, 71, 80, 136].

Personality Traits

Personality can be defined as “the ingrained patterns of thought, feeling, and behaviour characterising an individual's unique lifestyle and mode of adaptation, resulting from constitutional factors, development, and social experience” [145]. These general patterns become more fixed during adolescence and it is generally assumed that an individual's personality traits are a relatively stable entity during adulthood [27].

Personality research has come to a consensus that personality is a combination of different traits, which can comprise a number of factors; however, no consensus has been achieved regarding the number of factors and exactly what these factors are [40]. A five-factor model of personality, with the “Big Five” factors Neuroticism, Extraversion, Openness, Agreeableness, and Conscientiousness, has been postulated and is the basis for the widely used NEO Personality Inventory [26]. Eysenck [40], on the other hand, defends a three-factor model of Neuroticism, Extraversion and Psychoticism. He argues that Openness, Agreeableness and Conscientiousness in the Big Five are traits, not factors, and that they are included as part of the three factor model of Neuroticism, Extraversion and Psychoticism.

A different approach to assessing personality was chosen when developing the Karolinska Scales of Personality, which was revised to become the Swedish universities Scales of Personality, the SSP. These scales do not attempt to include and assess all aspects of personality, but focus on vulnerability factors, i.e. aspects that may place the individual at risk for psychiatric problems [51]. In a subsequent study in burn patients three Domains were identified and are evaluated in the SSP: Neuroticism, Sensation Seeking, and Aggressiveness [152].

Personality traits have been shown to play an important role both regarding the occurrence of trauma as well as the occurrence of problems after trauma [16]. In a prospective three-year study, individuals with high scores for Neuroticism and Extraversion had a higher risk of trauma exposure [16]. Furthermore, high Neuroticism scores and low Extraversion scores have been shown to be related to the development of PTSD [42].

In two follow-up studies, burn patients were shown to have higher Neuroticism scores than the general population [42, 152], and higher Neuroticism scores were associated with bad perceived health in burn survivors [70].

Coping strategies

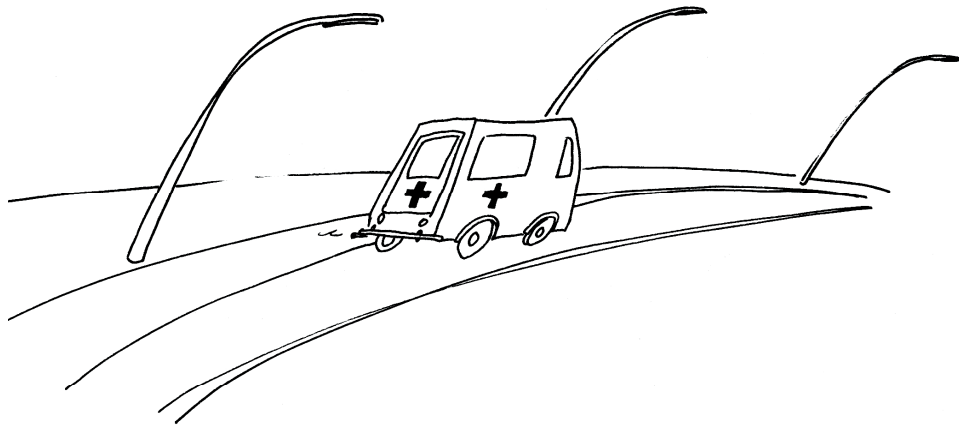
The ways in which a person handles stressful situations are called coping strategies [77], and these are linked to personality traits. Coping consists of the thoughts and behaviour that are used in an attempt to adapt to changes in life. Coping is neither positive nor negative in itself. The consequences for adaptation depend upon individual personality traits and the situational demands. Generally speaking, coping strategies can be divided into two main groups; attempts to avoid and attempts to approach the stressful situation. While avoidance may be necessary and beneficial immediately after trauma, approaching strategies seem to be of advantage later on [129].

The use of avoidant coping has been related to poor adjustment after burns [18, 71, 107, 149, 150], whereas the reported use of other strategies such as emotional support and problem focused coping has resulted in contradictory findings [99, 130, 136].

A number of problems encountered by burn survivors are burn-specific and burn-related. Therefore, the Coping with Burns Questionnaire [153] was developed as a burn-specific instrument that uses burn-related items (e.g. “I told others about the accident, the time in hospital or the problems I faced after discharge”). The CBQ was inspired by previous coping literature in the field of trauma, and the items were adapted from general coping scales such as the Revised Ways of Coping Checklist [45], the COPE [21] and the Brief COPE [20]. It reflects the burn-related coping style at the time of hospital discharge.

Psychiatric morbidity

A large proportion of burn patients have a history of psychiatric disorders [93] as well as higher levels of psychological distress after injury [94]. In a study of Swedish burn patients Dyster-Aas et al. found that 66 % of the individuals had at least one lifetime psychiatric diagnosis; the prevalence was 41% for major depression and 32% for alcohol abuse/dependence [37].



These prevalences are higher than those in a Norwegian urban population study [73], where the lifetime prevalences were 52% for any psychiatric disorder, and the prevalences are considerably higher than in a Norwegian rural population [74], which is a population similar to the one received at the Uppsala Burn Unit. Rural Norwegians have a lifetime prevalence for any psychiatric disorder of on average 31%.

The prevalences of psychiatric disorders are comparable to those from American studies. In a study by Fauerbach et al. examining DSM III-R axis I diagnoses in burn survivors, the lifetime prevalence of any diagnosis was 64 %, the prevalence of affective disorders was 31 %, and for alcohol abuse or dependence it was 41% [41]. Two comparable American population based studies from 1994 and 2005 showed prevalences of 48% and 46% for any psychiatric disorder [64, 65].

In patients with a pre-injury psychiatric history, the psychiatric disorder can contribute to the mechanism of the injury itself [105, 112]. These individuals appear to be more likely to have preventable injuries, require longer hospitalisation and have problems with adjustment early in their recovery [93, 105].

Outcome

Physical problems

The deeper the burn, the greater the risk of permanent and visible changes. Even in superficial burns, where surgery and skin grafting is not required, permanent changes can occur in the skin's appearance and quality, and this is always the case in deeper burns [119].

The newly healed skin cannot produce sebum and sweat, and as a consequence the healed burn is often dry. At this stage the skin has decreased mechanical tolerance, so that any kind of friction such as rubbing or scratching can cause new wounds [54, 104].

Scar maturation is accompanied by some degree of contraction; the deeper the damage, the greater the skin's tendency will be to contract [119]. Certain areas of the body, mainly the shoulders and the chest, have a greater risk of hypertrophic scar formation than others [106]. Furthermore, the skin has a tendency to heal by covering the shortest distance instead of following the original contours, which can be a problem particularly in areas where the body usually has a concave contour. In burns on the neck, for example, the scar will have a tendency to form a flat surface from the chin to the chest instead of the "normal" concavities from the jawline to the neck to the chest. Similarly, axillary burns will heal with scars that choose the shortest path between the arm and the chest, thereby restricting elevation of the shoulder.

Changes in pigmentation and appearance can occur even if no scars form, and these changes can persist [104]. Deeper burns in which the dermis is partly or completely destroyed will always result in scars [54, 119] and inferior mechanical [104] and sensory function [62, 89], as well as poorer temperature regulation [8, 11, 79]. Scars will change the individual's appearance, which can subjectively be experienced as disfigurement [136]. The scars can also encumber range of motion and lead to a loss of function [62]. Furthermore, in severe cases deep burns can cause the loss of body parts.

Pruritus (itching)

Pruritus is defined as an irritating skin sensation causing a desire to scratch. Although most burn survivors develop pruritus after burns, with an incidence of up to 87% [137], little is known about the causes of this problem [12, 95, 158].

In a Norwegian study, 57% of dermatological patients as well as 48% of a non-healthcare seeking group reported itchy skin [28]. In a second, large-scale population based Norwegian study, the prevalence of itching “quite a lot” and “very much” was around 10%, with a higher frequency in women and young adults [29].

It was thought that itch is transmitted along the same pathways as pain, but recent research has found that itching has its own neural pathways [5]. Itch-mediating neurons have recently been identified [116], which has improved our understanding of the underlying mechanisms of pruritus. These neurons are connected to chemonociceptors, which react to histamine and other mediators in the skin [12]. Itch caused by histamine is transmitted to the brain by a neural pathway via the spinothalamic tract in fibres specific for itch. These recent findings provide strong evidence that itch has specific neural elements both peripherally and centrally.

The itch-mediating neurons can be inhibited by pain, e.g. scratching. This also means that opioid pain medication may disinhibit the itch-specific neurons and thereby increase itching [116].

Itching can be the source of great distress in burn survivors. It can be annoying and distracting, it can affect the individual's ability to concentrate, and it can also disrupt nightly sleep, thereby decreasing the individual's ability to function in everyday life [10]. Scratching may damage the new skin and increase local inflammation, which can intensify the pruritus and prolong the healing process [52].

Information concerning the time course of pruritus after burns, especially after the first few years, is limited. A general clinical observation is that itching becomes most severe after re-epithelialisation of the burns, and although it usually subsides during the second year after the burn [54], it can persist for years.

An indication of the importance of underlying, psychological factors is the observation that stressful life events can increase itching, with great differences between individuals [44, 48, 72]. Personality features and psychiatric symptoms such as depression and anxiety are associated with increased pruritus in atopic dermatitis and urticaria [19, 127], however, little is known about whether these associations also apply to the prolonged pruritus that can occur after severe burns.

Posttraumatic Stress Disorder

Up to 90% of burn patients experience some symptoms of stress during the first weeks after a burn [38], and up to 45% of burn patients experience the chronic stress symptoms that can be classified as Posttraumatic Stress Disorder, PTSD, during the first year after injury [136].

In the 1970s Horowitz observed that individuals suffered from two types of responses to a traumatic event, “Intrusion” and “Avoidance” [60]. In 1980 the American Psychiatric Association included psychological problems after a traumatic event as a “disorder” in the Diagnostic and Statistical Manual of Mental Disorders third edition (DSM-III) [134]. Compared to Horowitz’s phenomenology, the DSM-III definition of PTSD included more aspects of posttraumatic stress. In addition to the symptoms of Intrusion (B criterion) and Avoidance (C criterion), there was a third symptom cluster of hyper-alertness (D criterion), as well as the requirement for exposure to “a recognisable stressor that would evoke significant symptoms of distress in almost anyone” (A criterion), and at least a six-month duration of the disorder (E criterion) [134]. The definition was revised for the fourth version of the DSM (DSM-IV), in which the A criterion was broadened, the E criterion was shortened to one month and a sixth criterion was added: the disorder should cause significant distress or impair functioning (F criterion) [6].

After more than 20 years in which PTSD formally has been defined as a disorder in the DSM, critical opinions are being voiced both on the concept of PTSD as a single disorder entity and on the idea that it is “caused” by trauma or similar threatening events [15, 83]. According to the authors of these publications many of the symptoms listed in the DSM are non-specific and can also be interpreted as symptoms of other problems, e.g. depression, or in the context of vulnerable personality traits. The DSM-defined disorder could therefore also be the persistence of a reaction to stress due to other psychological problems.

Follow-up studies show that the symptoms of response to stress, which will be called PTSD in this text for simplicity’s sake, persist in about 40% of afflicted individuals [81]. These studies also show that the persisting disorder is associated with a number of additional problems such as depression, risk for suicide, substance abuse and dependence, and cardiovascular disease. A person with PTSD will on average suffer 20 years of symptoms dur-

ing his or her lifetime and will on average experience work impairment one day per week because of the symptoms [63].

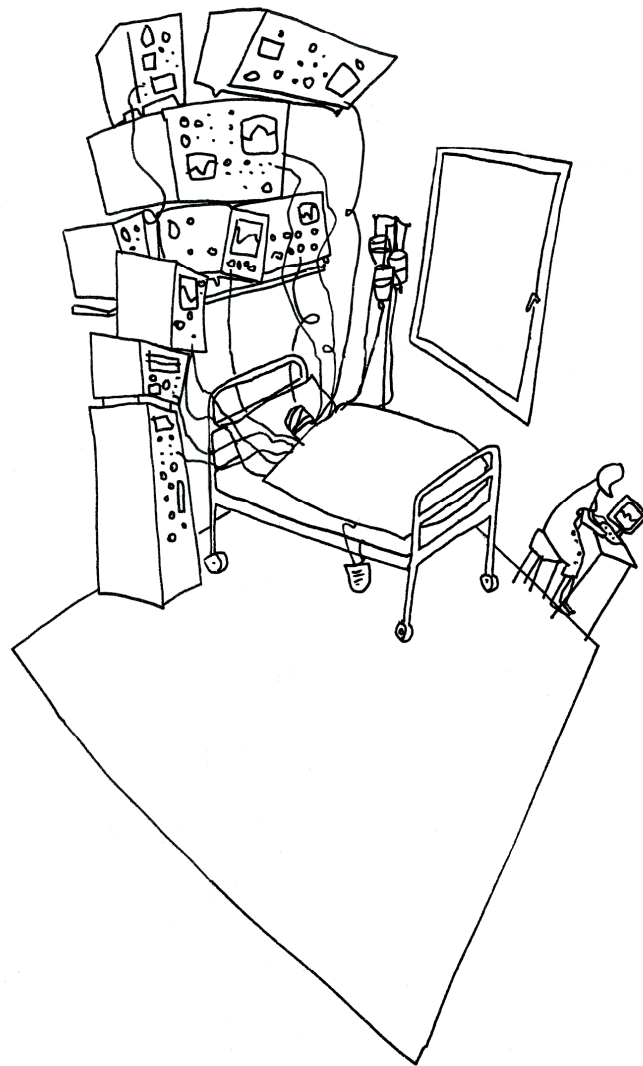
Individuals suffering from PTSD show avoidance of stimuli associated with the trauma, and reminders can trigger involuntary re-experiencing such as flashbacks. Avoidance may be one of the reasons why only a minority of individuals suffering from PTSD will seek help specifically for their problems [63]. In contrast, it has been observed that individuals with PTSD have a strong tendency to seek help for other, more somatic problems such as pain, gastro-intestinal or sleep-related problems [30]. The underlying disorder may therefore go unrecognised for a long period of time. Awareness and recognition of PTSD symptoms is therefore of paramount importance with respect to treatment.

In 1943 the first report of “neuropsychiatric complications” after a burn was published from the Cocoanut Grove fire disaster of 1942, in which 491 persons were killed [1]. Psychiatric assessments were made in 46 of the 131 patients who were treated for burns at the Boston City Hospital. These assessments showed that 25 individuals had “symptoms of general nervousness and anxiety neuroses lasting at least three months” and nine months after the disaster 13 individuals still had these symptoms. The study also examined possible reasons for the development of these psychological problems and observed that the size of the burn, respiratory involvement, or the percentage of persons who had lost friends and relatives did not differ between the group with problems and those who were free of symptoms. In contrast, it was observed that those who had psychological problems had either not lost consciousness or had only had a loss of consciousness of short duration.

After this first report the following factors have been examined regarding the development of PTSD in burn patients: burn size, burn location, disfigurement due to the burn, pain and anxiety, pre-injury psychopathology, traumatic events before the injury, personality traits and coping strategies, and gender [136]. No causative single factor has yet been found and many studies have reported contradictory results [136]. A recent study from our group points to pre-injury psychiatric history, i.e. the presence of affective disorders, substance use disorders, or psychiatric comorbidity at any time during lifetime, as risk factors for post-injury symptoms of PTSD [37].

Nightmares

Sleep is vital, and dreams are an important physiological element of sleep, whereas the repeated occurrence of dreams with frightening content, so-called nightmares, appears to be pathologic [90]. In a review of the literature Partinen and Hublin reported that about 3-9% of all adults have nightmares “always or often” and 5-29% have nightmares “now and then” [92]. Whereas there is no gender difference in children, women report nightmares between twice and four times as often as men [7].



Sleep consists of two different alternating phases: rapid eye movement (REM) sleep and non-REM sleep. REM phases enhance the processing of emotional memories, and most dreaming (especially vivid dreams with emotional content) occurs during REM sleep [108, 124, 128]. REM sleep increases after acute stress, possibly as a sign that information gained from the stressful experience is being computed and added to memory [102]. Waking experiences can be reflected in dreams, but it is mostly the general theme of the experience or the dominating emotion, rather than the actual event, that reappears in dreams [32].

Nightmares belong to a subgroup of parasomnias, i.e. phenomena that occur during the process of sleeping and that are usually associated with REM sleep [133], and they are defined by the International Classification of Sleep Disorders as “frightening dreams that usually awaken the sleeper from REM sleep”. In contrast, the DSM-IV criteria for Nightmare Disorder are the following [6]: A. Awakening with detailed recall of frightening dreams (usually during the second half of the sleep period). B. When the sleeper awakes there is no or very little disorientation and the content of the dream is remembered clearly. C. The dream or the awakening causes significant problems in functioning. D. The dreams are not caused by another mental disorder or substance abuse.

The criterion of awakening from the frightening dreams used by the DSM-IV to classify a dream as a nightmare has been criticised by some authors for being too conservative [90].

Whereas idiopathic nightmares (as defined by the ICSD-R and the DSM-IV) usually occur during the second half of the sleep period, the period in which REM sleep dominates, nightmares in conjunction with PTSD, so-called PTSD-nightmares, usually occur earlier on [115]. Furthermore, it has been observed that PTSD-nightmares are sometimes accompanied by body motions, a phenomenon that usually does not occur during REM sleep. These observations have led to a discussion concerning whether PTSD-nightmares may be a separate entity of parasomnias as distinguished from idiopathic nightmares (reviewed in Ross et al. [115]).

The prolonged occurrence of nightmares after trauma, i.e. nightly intrusions of the traumatic event into dreaming, is listed as one of the symptoms of PTSD, and it has been suggested that they may be one of the key elements of the disorder [6, 55, 75, 90, 115]. Sleep loss due to repeated and prolonged experience of nightmares will negatively affect physiological brain functions, social functioning and well-being in general [22, 33, 57]. The distressing and intrusive nature of the dream’s content can cause further malfunctioning, which adds more stress to the already stressful situation and frequent nightmares have been shown to be associated with suicidality [125]. Some authors have hypothesised that sleep disturbances are not a secondary effect of PTSD but that the connection may be the other way around; REM-sleep

disturbance may be the underlying problem and PTSD may be secondary [55, 103, 115]. An indication of the central role of REM sleep in PTSD is the observation that pharmacological reduction of REM sleep can alleviate PTSD symptoms (reviewed by Ross et al. [115]).

“Health-related quality of life”

Health is a complex concept that is closely related to well-being and quality of life. The World Health Organization defines health as “a state of complete physical, mental and social well-being and not merely the absence of disease and infirmity” [157]. This definition includes an infinite number of aspects that are difficult to assess without systematically leaving out important information. A different approach to measuring health is therefore to measure the degree of its absence, rather than attempting to measure its presence. This “health status” is an assessment of the impact of an illness on the individual’s ability to participate in life. The concept “health-related quality of life” combines this “health status” and the individual’s satisfaction with this current health status [139].

The Burn Specific Health Scale (BSHS), which was first published in 1982 [13], assesses burn specific aspects of health, and a number of revisions have improved its psychometric properties. A shorter, revised version, the Burn Specific Health Scale-Brief (BSHS-B), was published by our research group in 2001 [68], and a long-term follow-up using the BSHS-B in Swedish burn patients showed that a small group of patients have severe health problems, whereas most patients report few or no health problems. The most common health problems were associated with working ability and heat sensitivity of the skin [69].

Concurrent validity of the BSHS-B compared to other versions of the BSHS has been shown [68], as well as construct validity concerning its associations with injury severity and sociodemographic variables [36, 68], care utilisation [147], personality [70, 154] and coping [71, 150, 153], and dysfunctional beliefs [121, 151].

Background and Aims

This thesis is part of a major multidisciplinary project that was started in 1996 at the Uppsala University Hospital Burn Unit in collaboration with Uppsala University which has its focus on the outcome after severe burns injury. The Uppsala Burn Unit is one of two national burn units, and it has a catchment area covering the entire northern part of Sweden with approximately three million inhabitants.

The project is based on the concept that the characteristics of an injured person reflected in personality traits, coping strategies, other environmental factors and genetic disposition, and possibly a previous psychiatric history, will affect the adaptation process after injury. This occurs in interplay with characteristics of the injury itself and the additional stress during the long phase of hospital treatment (Figure 1).

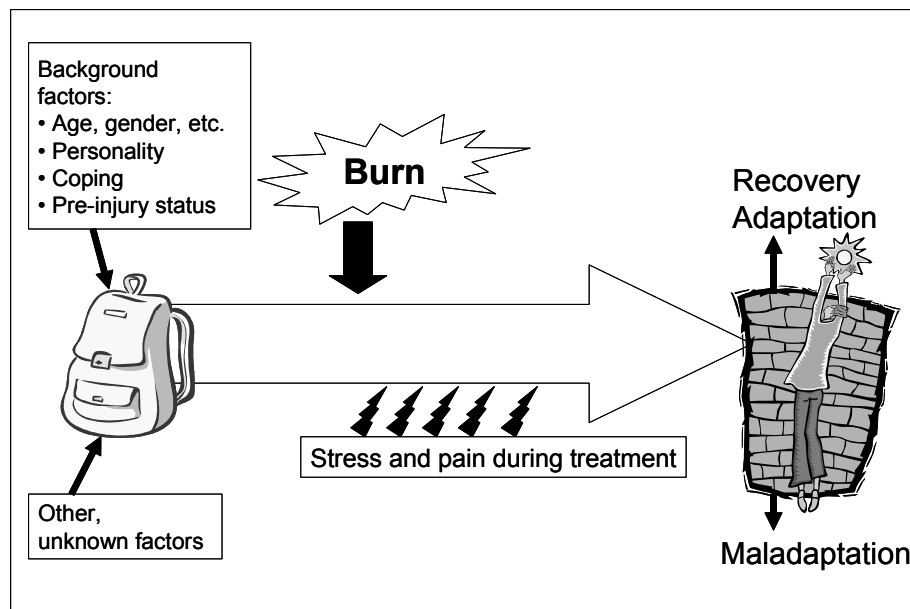


Fig. 1: A model of trauma and outcome

This thesis is based in part on previous results from the research group:

Mimmie Willebrand [148] developed the Coping with Burns Questionnaire, and found associations between avoidant coping and maladaptive personality traits, poorer perceived health status and psychological problems after injury. It was found that burn patients had higher ratings of Neuroticism than a normative sample and that burn survivors showed selective attention towards burn-related stimuli many years after the incident. She also observed that trauma-related questionnaires were well accepted by a majority of burn survivors.

Morten Kildal [67] developed the Burn Specific Health Scale–Brief, and demonstrated that not only issues related to the skin, work and body image were important problem areas in burn survivors, but also that personality and coping affected the perceived health outcome.

Johan Dyster-Aas [35] examined the impact of psychosocial factors and psychiatric morbidity on the post-burn prevalence of psychiatric disorders, short- and long-term adaptation after burns with special focus on long-term health as well as work-status after work-related burns, and predictors of return to work after injury.

In summary, these previous results supplied instruments for a better assessment of psychology and health in burn patients, and emerging evidence that psychological and psychiatric factors are important for both physical and psychological outcome after burns.

In this thesis these previous results were applied to broaden and deepen our understanding of physical and psychological problems after burns and to assess the quality of our instruments. More specifically, the aims of this thesis were:

- to assess the proportion of individuals who develop nightmares and pruritus after a burn,
- to identify risk factors for the development of these problems, and
- to examine the effect of psychiatric morbidity on perceived outcome after burns.
- to examine the effectiveness of asking about nightmares as a screening question for PTSD-symptoms, and
- to examine the validity of the IES and IES-R as measurements of PTSD.

Patients and Methods

Study populations

The papers included in this thesis are based on three separate samples of burn patients who were treated at the Burn Unit at Uppsala University Hospital. Individuals included in papers I and II were treated between 1980 and 1995. Paper III is based on a study of former burn patients who were treated between 1996 and 2000. Papers IV and V are based on a prospective study of consecutive burn patients admitted to the Burn Unit between March 2000 and January 2005. The socio-demographic and burn-related data for the different patient populations are shown in Table 1.

1980-1995 cohort

In 1996, all patients treated at the Uppsala University Hospital Burn Unit from 1980 to 1995 were identified in order to assess health status [68]. The inclusion criteria for this study were: an age of 18 years or older at the time of follow-up, a burn size of 10% or more of the total body surface area (TBSA) or a length of stay (LOS) of more than 7 days irrespective of TBSA burned.

In all, 334 former patients were identified and approached, and a total of 248 former patients (74.3%) returned the health survey comprising 94 items from different versions of the Burn Specific Health Scale [68]. Of these 248 individuals, all who had been 15 years or older at the time of injury were approached a second time in 1999 to assess their personality traits and the coping strategies they had used after discharge from hospital. In order to increase the likelihood that participants would be able to remember the time after discharge from hospital, individuals who had been younger than 15 years at the time of injury were excluded. This selection reduced the number of participants to a sample of 227. Information regarding the study purpose, questionnaires, and prepaid return envelopes were sent to these former patients. Of the 227 individuals, 166 (73.1%) completed the questionnaire on personality traits and 161 (70.9 %) also completed the questionnaire on coping strategies. These 166/161 responders constitute the basic groups of patients in papers I and II.

Table 1. Socio-demographic and burn-related data concerning the participants in papers I-V

Paper	Cohort	Total n	Included n	Response rate	M/F	Age at injury	Age at investigation	TBSA burned (%)	TBSA FT (%)	LOS (d)	Years after injury
	1980-1995	334	248	74.3 %	199/49	37 (16)	46 (16)	23 (16)	7 (9)	31 (29)	9 (5)
I		227	166	73.1 %	132/34	39 (14)	50 (14)	25 (16)	8 (10)	30 (25)	11 (5)*
II		227	161	70.9 %	127/34	38 (14)	48 (14)	24 (16)	7 (9)	30 (25)	11 (5)*
III	1996-2000	116	85	73.3 %	62/23	43 (17)	47 (17)	17 (15)	8 (11)	22 (23)	4 (1)
	2000-2005										
IV		86	50	58.1 %	38/12	45 (16)	45 (16)	29 (22)	12 (16)	31 (32)	na
V		86	63	73.3 %	47/16	45 (16)	45 (16)	25 (21)	11 (15)	26 (30)	na

Values are means (SD). M/F = males /females. TBSA burned = total burn size, TBSA FT = size of the full thickness burn, LOS = length of stay on the Burn Unit. na = not applicable. * evaluation of pruritus and nightmares at 9 (5) years after injury, evaluation of personality and coping at 11 (5) years after injury.

January 1996 - March 2000 cohort

Individuals included in the study that paper III is based on were recruited from a group of patients who had been admitted to the Burn Unit between January 1996 and March 2000, and who were 18 years or older at the time of the investigation in October 2001. One hundred and forty-seven former patients were identified, of whom 31 could not participate; 19 individuals had died since discharge from hospital, four did not live in Sweden, six could not be contacted because they did not have a registered address, and for two individuals relatives reported that they could not participate because of dementia. A questionnaire on health status, personality traits, coping strategies, satisfaction with care, and socio-demographic information, together with an information letter and a prepaid return envelope, were sent to the remaining 116 individuals. Eighty-five former patients (73.3%) returned the completed questionnaire and these individuals constitute the study sample in paper III.

March 2000 – January 2005 cohort

Participants in papers IV and V were consecutive patients admitted for treatment on the Burn Unit between March 2000 and January 2005. For this group the following inclusion criteria were used: an age of 18 years or older, proficiency in the Swedish language, no known cognitive dysfunction or dementia, and a burn size of more than 5 % TBSA, or a LOS of longer than one day on the Burn Unit. Patients who were temporarily admitted but had their main care provided elsewhere were not included.

The study consisted of two parts. In the first part, patients, after giving their informed consent, were asked to answer questionnaires and were interviewed during acute hospitalisation as soon as possible. The second part of the study was performed at 12 months after injury.

Eighty-six individuals fulfilled the inclusion criteria in the studies described in papers IV and V.

In the study described in paper IV, 36 individuals did not complete the study ($n=27$) or their data could not be included ($n=9$), why the results are based on 50 individuals (58 %). Of the individuals who did not complete the study, ten declined participation when asked during hospitalisation, five declined participation in the follow-up, two individuals could not be interviewed at the 12-month follow-up (one had died and one had emigrated), five individuals did not answer the IES-R at follow-up and five individuals were not included for administrative reasons. Finally, nine individuals were excluded as the time between IES-R and SCID-I was too long or not assessable.

For the study described in paper V, 23 of the 86 individuals did not complete the study (26.7%); ten individuals declined participation when asked

during acute hospitalisation, one did not participate in the follow-up, and six did not answer the BSHS-B. Five individuals were not included in the study for administrative reasons and one individual had died during the year after injury.

All 50 individuals who were included in paper IV were also included in paper V.

Instruments

Swedish universities Scales of Personality, SSP

The SSP is based on the widely used Karolinska Scales of Personality (KSP), which is an inventory designed to measure personality traits, especially those that are believed to have a biological basis and are associated with psychopathology [50]. The KSP was shortened, psychometrically evaluated, and revised, and was named the SSP [51]. The SSP contains 91 items divided into 13 scales with seven items in each (Table 2). Based on factor analysis, these scales are grouped in three broad Domains named Neuroticism, Sensation Seeking and Aggressiveness [152].

Each scale has seven items with answers ranging from 1 = "does not apply at all", to 4 = "applies completely". The individuals were asked to describe how they generally would describe themselves. The SSP has been standardised into T-scores with means of 50 and SDs of 10 in a representative national sample of 741 Swedes [51].

Coping with Burns Questionnaire, CBQ

The CBQ scale is designed to measure coping in burn patients after discharge, and a majority of the items are burn- or trauma-related [153]. It contains 33 items grouped into six scales (Table 2).

The answers range from 1 = "does not apply/not used" to 4 = "used a great deal".

In the questionnaire used in papers I and II, participants were asked to recall their situation after discharge from treatment for the acute burn and how they had dealt with problems at that time. The reason for asking the individuals about how they had coped during the time after the burn instead of asking about their current coping strategies was because the follow-up time in this group was up to 18 years after injury. It was thought that information on current coping strategies might not reflect the coping used after the burn. In the questionnaire used in all subsequent follow-up studies, the patients were asked how they dealt with current situations and problems.

Table 2. Description of SSP- and CBQ-subcales [51, 153]

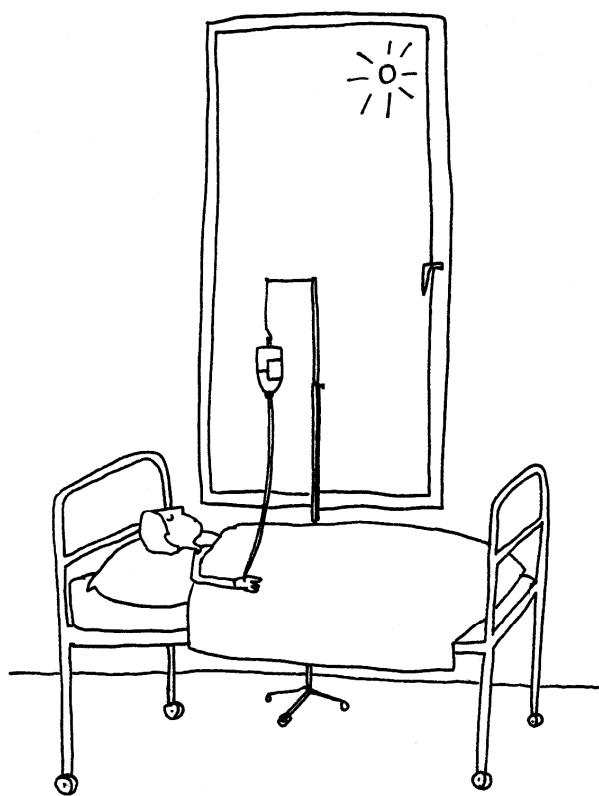
SSP subscales	Description of individuals with high scores
Somatic Trait Anxiety	Restless, tense, focused on somatic problems
Psychic Trait Anxiety	Worrying, anticipating, lacking self-confidence
Stress Susceptibility	Easily fatigued, uneasy when urged to speed up
Lack of Assertiveness	Lacking forcefulness in social situations
Detachment	Avoiding engagement with others, withdrawn
Embitterment	Unsatisfied, blaming and envying others
Trait Irritability	Irritable, lacking patience
Mistrust	Suspicious, distrusting other person's motives
Impulsiveness	Acting on the spur of the moment, non-planning
Adventure Seeking	Avoiding routine, need for change and action
Social Desirability	Socially conforming, need to be friendly and helpful
Verbal Trait Aggression	Getting into arguments, berating when annoyed
Physical Trait Aggression	Getting into or starting fights, uses violence, hits back

CBQ subscales	Description of item
Revaluation/Adjustment	Adjusting life style to injury, seeking meaning, attempting to set injury into perspective
Avoidance	Avoiding activities/people, daydreaming, wishful thinking
Emotional Support	Seeking social contact and emotional help from others, talking about the injury and problems
Optimism/ Problem solving	Trying to see a brighter side of the situation and the future, efforts to solve problems
Self-control	Emotional restraint
Instrumental Action	Seeking practical help and advice, making action plans

Burn Specific Health Scale, BSHS

The BSHS-B assesses nine different areas of perceived health status in a general time frame after a burn, and not only at the time of the questionnaire [68], in both psychosocial and physical aspects of health in the subscales Affect, Body Image, Interpersonal Relationships, Sexuality, Heat Sensitivity, Simple Abilities, Treatment Regimens, Hand Function, and Work. In 40 items, the individual assesses the amount of difficulty she or he has in the different areas, and the items can be answered on a five-step scale ranging from 0="extreme(ly)" to 4= "not/none at all". Because the BSHS is, as its name implies, a "health scale", the more difficulties an individual reports, the lower the score.

Two items from the original BSHS, but which are not parts of BSHS-B, were also used for the studies presented in this thesis. They are the item that



assesses the frequency of self-reported nightmares, “I have nightmares”, and the item that assesses amount of pruritus; “My burn itches a lot”. Both items could be answered on a five-step scale: 0 = “always”, 1 = “often”, 2 = “sometimes”, 3 = “seldom” or 4 = “never”.

DSM-IV related items concerning nightmares

Three items based on the DSM-IV criteria for nightmares [6] were constructed for this study. The first item was “I suddenly awake at night with detailed memories of frightening dreams”, which could be answered on a four-step scale ranging from “I do not have problems with nightmares”, to “(it happens) once a week”, to “several times a week”, to “every night”. The other two DSM-IV items were “When I awake, I quickly (within a few minutes) understand that it was a dream”, and “Because of the nightmares I have problems functioning at work, at my studies or in other important situations the next day”. These two items had three response categories: “I do not have problems with nightmares”, “agree” and “do not agree”. (For a detailed description of the items see Table 1 in paper III.)

Impact of Event Scale, IES

The “Impact of Event Scale: a measure of subjective stress” (IES), which was published by Horowitz in 1979 was based on an empirically derived phenomenology, with the two responses to a traumatic event being “Intrusion” and “Avoidance” [60]. In 1997 Weiss and Marmar attempted to achieve a “complete assessment of the response to traumatic events” [143] by adding seven hyperarousal symptoms to the original IES, and this new scale was called the Impact of Event Scale-Revised (IES-R). The IES-R with its three subscales has a structure similar to the definition of PTSD in DSM-IV. It is, however, not directly comparable, as it only assesses symptoms of PTSD and not the other three criteria required by DSM-IV, i.e. exposure to a traumatic event (criterion A), duration of symptoms (criterion E) and functional impairment (criterion F).

The Swedish version of the IES-R has seven items for Intrusion, eight items for Avoidance, and seven items for Arousal. The wording from the original IES was used [60], as was the four-step scale: 0 = “(applies) not at all”, 1 = “rarely”, 3 = “sometimes”, and 5 = “often”. The items refer to the past seven days.

According to Horowitz, the author of the original IES [59], zero to eight points on one subscale can be considered as low PTSD symptomatology, nine to 19 points indicates moderate PTSD symptomatology, and 20 or more points can be interpreted as high PTSD symptomatology.

Structured Clinical Interview for DSM-IV Axis I disorders, SCID-I

To assess psychiatric disorders, the Structured Clinical Interview for DSM-IV Axis I disorders (SCID-I) [43] was used, which is a widely utilised and thoroughly researched psychiatric clinical instrument [155]. For the studies included in this thesis, all interviews were performed by two interviewers, neither of whom was involved in clinical treatment on the Burn Unit. Six interviews were independently rated by both interviewers as a test of interrater reliability, and complete interrater agreement for the diagnoses was obtained.

The first SCID-I interview on pre-injury psychiatric morbidity was conducted during acute care. This interview assessed criteria for psychiatric diagnoses both during the patient's "lifetime", defined as "at any time in life before and including the time of the burn", and "12 months before the injury", defined as "some time during the 12 months before and including the time of the burn". Twelve months after injury the patients were again approached and a second SCID-I was conducted for assessment of PTSD criteria [43]. Besides evaluation for the full PTSD diagnosis according to DSM-IV, the presence of the diagnosis of subsyndromal PTSD according to Mylle and Maes [87] was evaluated, with the requirements of functional impairment (criterion F) in addition to at least one symptom in each of the three criteria B, C, and D.

Data analysis

All data analysis was performed using SPSS software (SPSS Inc.).

Different groups were compared in χ^2 analyses and using Spearman Rank Correlations and by Student's t-tests.

In papers I, II and V, logistic regression analyses were used to calculate the strength of a hypothesised association between different factors.

The strengths of the logistic regression analyses were evaluated by the "effect size" of the independent factors on the dependent variable and expressed as the Nagelkerke R^2 [88].

In papers III and IV, Sensitivity, Specificity, Discriminant Ability (DA), and Likelihood Ratios (LR) for a positive and negative test were calculated. These values were used to determine the best way to screen for high PTSD symptomatology using questions about nightmares (paper III), and the optimal cutoff for the IES-R total score in the validation against the SCID-I (paper IV). The Sensitivity of a test describes the proportion of individuals a test identifies as having the disorder in a group of individuals who actually have the disorder. Concurrently, Specificity describes the proportion of individuals a test identifies as not having the disorder in a group of individuals

who actually do not have the disorder [100]. The Discriminant Ability (DA) of a test is the mean value of Sensitivity and Specificity and a measure of the amount of information that can be gleaned from a test [110]. A “perfect” test would give the perfect amount of information, i.e. 100%, whereas a test with a DA of 50% would supply no information.

Likelihood ratios [100, 110] are a measure of the usefulness of a test, and they can also be used to compare tests [47, 100]. They are the likelihood that the result is “correct” vs. “false”.

The LR for a positive test result (LR+) is calculated as:

$$\text{sensitivity}/(1-\text{specificity})$$

and the LR for a negative test (LR-) is defined as:

$$(1-\text{sensitivity})/\text{specificity}$$

As the Likelihood ratios are a ratio of two probabilities, values of 1 indicate that the test will not supply useful information (it is as probable that the test is correct as it is probable that the test supplies a false result). The higher the LR+, and the closer the LR- is to zero, the more useful this test is for detection and ruling out [100].

In paper IV the reliability of the three IES-R subscales was calculated and expressed as Cronbach’s α .

Ethics

All studies were performed according to the principles of the Helsinki Declaration and were approved by the Uppsala University Ethics Committee.



Results

Pruritus, personality traits and coping (paper I)

Chronic burn-related pruritus is rather common, and psychological factors such as anxiety-related traits and coping are significantly associated with its presence. With increasing time after injury, the amount of pruritus decreases and use of the coping style Emotional Support appears to be protective.

One hundred and three (42%) of the 248 individuals studied reported no burn-related pruritus (rating 4 = “never”), 108 (44%) reported occasional pruritus (ratings 2 = “sometimes” and 3 = “seldom”), and 37 (15%) reported persistent pruritus (ratings 0 = “all the time” and 1 = “most of the time”). The relative number of individuals who experienced no pruritus increased over time from 21% in those whose injury had occurred within the past four years to 56% in those whose injury had occurred more than 12 years previously. Using the same time frame, there was a slight decrease in patients reporting occasional pruritus (from 50% to 39%) and a considerable decrease in patients reporting persistent pruritus (from 29% to 5%).

In the first step, the independent variables gender, age at injury, time after injury, burn size and personality traits and coping strategies were evaluated in simple logistic regression analyses. In the second step, all relevant variables were then entered into a multiple regression with backwards exclusion of non-significant variables.

In the first regression analysis “no pruritus” was compared to “pruritus”, i.e. pruritus of any frequency above “never”. In this analysis the somatic background variables explained 9% of the likelihood of having pruritus. After inclusion of psychological variables and backward elimination of non-significant variables, Psychic Trait Anxiety, together with time after injury and burn size, explained 16% of the likelihood of having pruritus (negatively, i.e. the longer the time after burn, the less pruritus).

A second regression analysis was performed in which “no pruritus” was compared to “persistent pruritus”. The model (Table 3) included time after injury, burn size, the neuroticism-related personality trait Lack of Assertiveness, the coping strategies Instrumental Action, and Emotional Support (negatively, i.e. the more Emotional Support was used, the less pruritus).

This final model explained 39% of the likelihood of having persistent pruritus.

Nightmares after burns (paper II)

Nightmares often occur after burns, but they become less frequent with increasing time after injury. The study showed that neuroticism-related personality traits and coping strategies can increase the risk of having nightmares after a severe burn. The modification of coping strategies may be a possible approach of prevention or treatment of nightmares after injury.

Of the 166 patients who answered the BSHS-item and the SSP, 72 (43%) reported nightmares. Fifteen patients (9%) always or often had nightmares and 57 (34%) said that they sometimes or seldom had nightmares. A higher percentage of women than of men reported nightmares (odds ratio 3.0; 95% confidence interval 1.4-6.6). Furthermore, the frequency of nightmares was related to the size of the full-thickness burn ($p=0.012$), but not to the total burn size. Moreover, the frequency of nightmares was related to time after injury ($p=0.03$). Whereas 56% of all patients reported having nightmares during the first four years after injury, only 33% reported having nightmares >12 years after injury.

In a first step, two separate logistic regression analyses were used to assess the association between personality traits (both on a domain- and a trait-level) and the frequency of nightmares on the one hand, and the association between coping strategies and the frequency of nightmares on the other.

In a second analysis, personality traits and coping were entered together as independent factors to gain further information concerning the relationship between these variables and the frequency of nightmares.

In this combined analysis frequent nightmares were related to the coping strategy Reevaluation/Adjustment, the personality traits Trait Irritability and Lack of Assertiveness, gender, and full thickness burn size (Table 3). The effect size of these five factors was 54 %.

Table 3. Final statistical models with personality and coping as independent variables and a high frequency of nightmares (n=15) or persistent pruritus (n=37) as dependent variables. Data from papers I and II.

	Pruritus (R²=0.39)		Nightmares (R²=0.54)	
	χ^2	p	χ^2	p
Time after injury	8.9	0.003	-	-
Gender	ns	ns	4.1	0.043
Total burn size	6.3	0.012	-	-
Full-thickness burn size	-	-	5.7	0.017
Lack of Assertiveness	5.6	0.018	6.1	0.013
Trait Irritability	-	-	7.7	0.050
Revaluation/Adjustment	-	-	4.4	0.036
Instrumental Action	7.0	0.008	-	-
Emotional Support	4.2	0.039	-	-

Nightmares and PTSD after burns (paper III)

In this study a question about the presence of nightmares was shown to be a useful screening tool to detect the presence of high PTSD symptomatology. Two different ways of assessing the presence of nightmares were compared, the BSHS item “I have nightmares” and three items based on the DSM-IV criteria. A possible practical application of this screening test for PTSD symptomatology could be to start with the most concrete question, “Do you have nightmares?” (BSHS item) and then ask how often the nightmares occur (to differentiate between incidental occurrences and recurrent nightmares).

Concerning the BSHS item “I have nightmares”, five individuals answered “always”, three “often”, 13 “sometimes”, 18 “seldom” and 45 “never”. The frequency of nightmares was correlated to the amount of PTSD symptomatology on all three IES-R subscales (range of $r = -0.55$ to -0.64 , all p -values <0.0001); the more frequent the nightmares (reflected in lower BSHS-scores), the higher the IES-R scores.

Fourteen (17%) of the 85 patients reported nightmares that fulfilled all three DSM-IV criteria for nightmares. In this group a larger proportion had high PTSD symptomatology in the three different IES-R subscales compared to the group that did not report nightmares [$\chi^2 (1) = 20.1$ to 25.6 , $p < 0.0001$ for all three analyses]. In the subscale Intrusion, 71% of the patients with nightmares had high PTSD symptomatology compared to 13% of the pa-

tients who did not report nightmares. The corresponding figures for the subscale Avoidance were 57% and 9 %, respectively, and for the Arousal subscale they were 56 % and 6 %, respectively.

The BSHS item “I have nightmares” had a higher DA and a greater detection and exclusion strength (high LR+, low LR-) compared to the DSM-IV based questions.

Discriminant Ability was highest for the approach in which the BSHS item was used, with an intermediate model for categorisation. A test in which “I have nightmares” “always”, “often”, or “sometimes” was interpreted as “nightmares”, and “I have nightmares” “seldom” or “never” was interpreted as “no nightmares”. Discriminant Ability for this approach was between 0.78 and 0.89.

Validation of the IES-R (paper IV)

This study showed that the Hyperarousal subscale of the IES-R and the total IES-R had comparable agreement with the SCID-I and the best properties as screening tools for PTSD one year after burns.

The aim of this study was to validate the Swedish version of the IES-R in burn patients using SCID-I. Furthermore, the scale and the three subscales were assessed regarding their ability to assess PTSD in burn patients one year after injury. Different total scores for scales and subscales were evaluated to determine the best cutoff value with the highest sensitivity and discriminant ability.

The study showed that the IES-R but also the Hyperarousal subscale can be used as a screening test for the diagnosis of PTSD in burn survivors. The optimal cutoff for the total IES-R score was a value of 39. Although this cutoff produced an overly inclusive test in which the group classified as positive for PTSD had a fourfold probability of a true positive result instead of a false positive result ($LR+ = 3.9$), no individual with a PTSD diagnosis was missed ($LR- = 0$).

The subscale Hyperarousal performed even better than the entire IES-R with a DA of 0.9 at the optimal cutoff of ≥ 13 and the $LR+$ at this cutoff was 4.8.

Psychiatric morbidity and outcome (paper V)

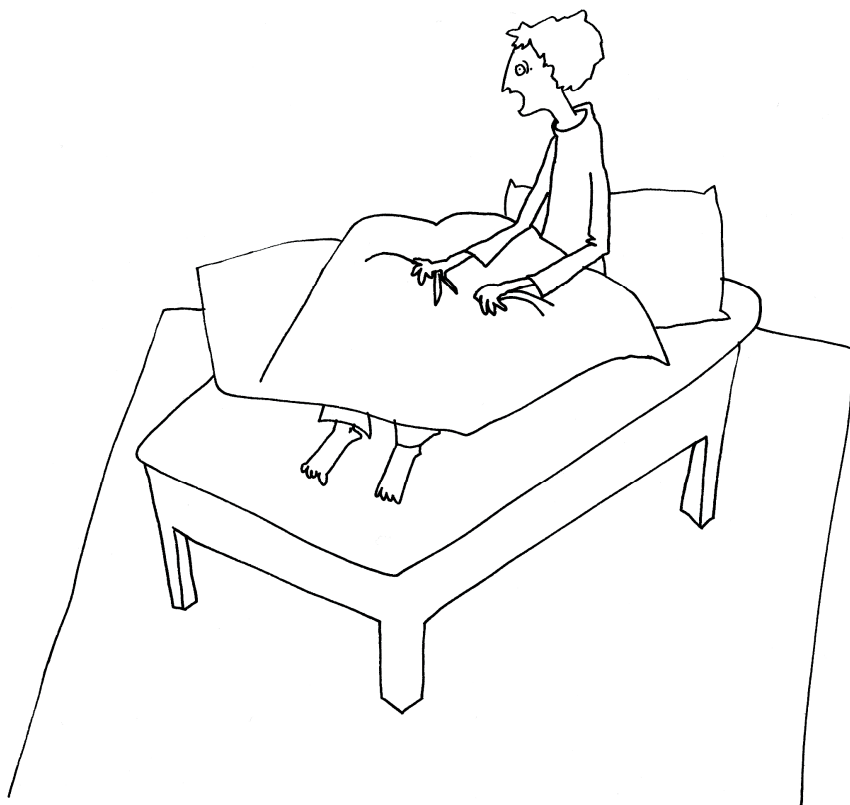
This study showed that psychiatric morbidity before injury is related to the risk of bad outcome for many aspects of perceived health at one year after a burn. Furthermore, psychiatric morbidity not only predicts bad outcome for aspects of psychosocial health such as Affect, Body Image, and Interpersonal Relationships, but also for some aspects of health and outcome after

burns that are generally assumed to be physical domains, such as Heat Sensitivity and Treatment Regimens.

We hypothesised that individuals with psychiatric morbidity would have a risk of bad perceived outcome after injury. The aim of this study was to examine whether psychiatric morbidity, defined as the presence of one or more psychiatric Axis I diagnoses according to the DSM-IV at any time during life before the burn could predict perceived health after burn, measured with the Burn Specific Health Scale-Brief (BSHS-B).

The statistical strategy chosen for this study was logistic regressions with the variables for psychiatric morbidity, as well as the covariates age, gender, burn size (both total burn size and size of the full-thickness burn), and length of hospital stay as independent variables. The dependent variables in this regression were perceived health in the form of the dichotomized results of the nine BSHS-B domains.

In the best fit regression models pre-injury psychiatric morbidity predicted bad outcome in six of the nine domains: Heat Sensitivity, Treatment Regimens, Body Image, Affect, Interpersonal Relationships, and Sexuality. In general, lifetime disorders were of stronger predictive value than the presence of disorders during the 12 months before injury, except for Interpersonal Relationships, which was best predicted by the presence of Any affective and Any anxiety disorder during the 12 months before injury.



Discussion

This thesis is the continuation of a line of studies on outcome after severe burns. Its aim is to broaden and deepen our understanding of physical and psychological problems after burns and it also assesses the quality of our instruments. The results show that personality characteristics, coping and the presence of pre-injury psychiatric illness contribute to various aspects of outcome. The frequency of nightmares after a burn was shown to be a good screening test for high IES-R scores, and the IES-R in turn was validated as a screening instrument for PTSD in burn survivors.

Methodological considerations

Sample

The samples upon which the studies in this thesis are based are representative for the Swedish population and the populations of other countries with comparable social standards. The Burn Unit in Uppsala has a catchment area that covers the northern half of Sweden, an area of about three million inhabitants, and the majority of individuals in the studies are from this population. The selection bias in all three cohorts was furthermore kept at a minimum by including consecutive patients and by only excluding individuals who could not answer the questionnaires, either because of inadequate cognitive function or language barriers. To reliably exclude an individual on the basis of these criteria, the diagnosis of inadequate cognitive function was made either after reviewing information in the patient charts, or based on direct information from the patient's relatives, or by testing with the Mini Mental State Examination (paper V). The Swedish population register also enabled a tracking of nearly every individual, even many years after injury, which helped keep participation rates high.

On the other hand, the incidence of burns in the population and therefore the number of individuals in the studies, is relatively low, which in part may be due to a high social standard and high levels of household safety and work safety in Sweden. Statistical evaluation and interpretation of results were limited by the small sample size, especially in papers III-V.

Methods

Except for the SCID-I-interviews used in papers IV and V, all information was gathered in self-report questionnaires. Although this method avoided an interviewer-introduced bias, there is a risk of self-report biases such as a general tendency not to give extreme answers, but rather to give socially desirable responses [24]. On the other hand, the advantage of the use of self-report instruments in these studies was that they enabled the collection of a large amount of information from consecutive cohorts of burn survivors from the whole of northern Sweden, which would not have been feasible in the form of interviews.

One of the strengths of this thesis is the use of the SCID-I for the assessment of psychiatric morbidity and the presence of PTSD; this semi-structured interview is a gold-standard method for assessing the major axis I psychiatric disorders [159]. It may be argued that the Clinician-Administered PTSD Scale, CAPS, is superior to the SCID-I, as it is used specifically for the assessment of PTSD after trauma [3, 142]. This scale may be more specific for the evaluation of PTSD, but the SCID-I enables an assessment of a broad spectrum of psychiatric morbidity in one interview, which was also an important objective for the study. As the burn survivors who participated in the follow-up studies were asked to answer several questionnaires and underwent a number of examinations and interviews during follow-up, it was important to keep a balance between in depth-assessments and efficacy. In this setting the SCID-I was considered to be superior to the CAPS.

Design

One of the limitations of papers I and II is that the assessment of coping strategies and personality traits was made two years after the first assessment that examined the presence of pruritus and nightmares. Furthermore, the results concerning coping could have been influenced by a recall bias as the participants were asked about coping strategies they had used during the time after discharge from hospital, which was 11 ± 5 years previously. The individuals may have forgotten how they coped at that time, or their memories may have been biased.

Although it has been shown that individuals can have a recall bias when describing the coping strategies they used [126], there was no association between time after injury and the amount of coping reported in the present material [153]. The coping strategies an individual remembers using probably reflect that individual's general coping style, rather than actual behaviours. Associations found in these studies between pruritus and nightmares, and coping strategies and personality traits should be interpreted as indications of general associations and not direct effects.

As personality traits are relatively stable in adults [27, 34, 50, 111, 131], their assessment should not be affected to a great extent by the time lapses between injury and the two assessments.

Furthermore, we did not differentiate between nightmares related to the burn and other nightmares. This may not be necessary, however, as it is unclear whether such a differentiation is possible. The content of the nightmare may not define its relationship to an incident as much as the emotions evoked by the dream. If the individual experiences the feeling of helplessness during an incident, the nightmares may reflect this feeling rather than replaying the actual event [32].

The item “my burn itches a lot” is phrased in a leading manner, which may have increased the participants’ ratings. The answers ranging from “all the time” to “never” do not reflect the intensity of the itching and may have been misunderstood: A burn survivor whose burn “never” itched a lot, but itched a little bit “all the time” would not be able to report this situation when responding to the item. On the other hand the “imprecise” wording in one item on pruritus may have been able to identify a larger number of individuals who had some kind of problem with itching than a more specific description of the problem could have done in a single item. Furthermore, the symptom of itching is in itself a subjective phenomenon, so that it is unclear how the wording could have been formulated more precisely to suit everybody. In a Norwegian population based study a simple instrument for the evaluation of skin morbidity was developed, validated, and then used in 18 747 individuals [28, 29]. Similarly to our study, one item was used in these studies to evaluate pruritus: “Do you have itchy skin?” was used and the possible answers ranged from “no” to “yes, very much”.

In paper III the strong correlation between the outcome for the BSHS item “I have nightmares” and the IES-R subscale Intrusion may be related to the fact that the IES-R Intrusion subscale contains a question about trauma-related dreams (though not specified as nightmares). However, this partial conceptual overlap of the two methods would not affect the other two subscales, Avoidance and Arousal. As we found correlations of similar strength between the BSHS item and scores on all three subscales, we assume that the results are not only a reflection of a conceptual overlap.

Papers III and IV showed that an item for the assessment of nightmares, the subscale Hyperarousal, and the IES-R were good screening tests for high IES-R scores (nightmares) or the diagnosis of PTSD (Hyperarousal and IES-R). All tests were overly inclusive and this can be regarded as a strength of such screening tests, rather than an unwanted effect: it has been recommended that psychiatric screening tests should be overly inclusive, as a false positive result would probably have no greater consequence than an “unnecessary” interview (e.g. SCID-I), but a missed diagnosis (falsely negative result) could have much more serious effects [23, 123].

In paper IV, a positive diagnosis of PTSD was defined as both full PTSD according to DSM-IV and subsyndromal PTSD according to Mylle and Maes [87]. The small number of individuals with full PTSD may compromise the interpretation of the results in this paper. On the other hand, the criterion of impaired function needs to be fulfilled to make the diagnosis of subsyndromal PTSD and the only difference between full PTSD and subsyndromal PTSD is a lower requirements on number of symptoms [87]. Therefore, individuals with subsyndromal PTSD would be in need of treatment and follow-up as much as individuals with “full” PTSD and this study showed that the IES-R was a useful screening test for all such individuals.

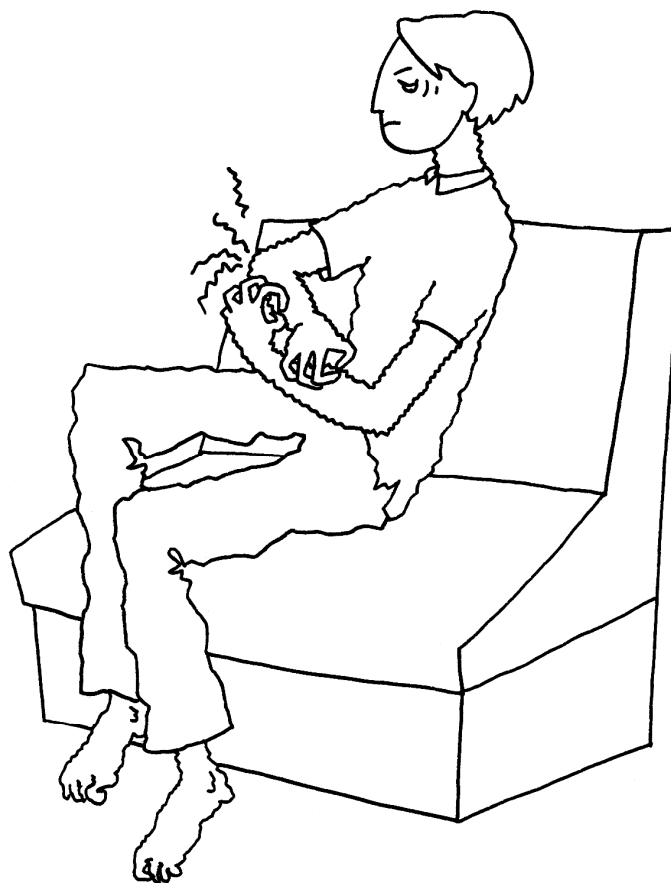
The number of individuals included in paper V is relatively small, so that the multiple regression analyses should be interpreted with caution. Such caution is especially warranted as many of the independent variables are known to intercorrelate to a certain extent. The regressions are therefore more robust on the overall level of psychiatric morbidity than on the level of individual DSM-IV diagnostic groups. In contrast, the prospective and longitudinal design and the use of a gold-standard interview to investigate psychiatric morbidity, as well as the high participation rate, are important strengths of this study.

The post-burn skin

Problems during and after wound healing

Wound healing after a burn is a long process: usually, all or most of the injuries are covered with new epithelium when the patient is discharged from the burn unit, but underneath the repair of damaged connective tissue continues in the form of a dynamic remodelling process [78]. This remodelling may last for more than a year, and during this time there is a low grade inflammatory process with the synthesis and degradation of new collagen [78, 118]. A large number of cellular and molecular processes cooperate in this process, and the release of pro-inflammatory neuropeptides from the efferent nerves in the skin is relevant for this thesis: some of the mediators of inflammation and proliferation, e.g. histamine and substance P are also pruritic [12]. This may be an explanation for why the healing of wounds is often accompanied by some degree of itching. Furthermore, inhibition of pain by opioids may reduce the inhibitory effect of pain on itching, thereby enhancing the itch [116].

In a study of patients with superficial burns, Altun et al. [4] were able to show that Substance P concentrations were not increased compared to concentrations in unburned skin. In contrast, Substance P concentrations were found to be elevated in hypertrophic scars [117]. This could also explain



why hypertrophic scars, which have high Substance P concentrations, have a tendency to itch for as long as the scar is red and elevated, whereas superficial burns, which heal without scarring and have low Substance P concentrations itch for a shorter time.

Another phenomenon is “neuropathic itch” [138], in which there is no inflammation, but spontaneous neural activity that is supposed to be caused by nerve damage. Such nerve damage and regrowth can for instance be seen in the scars and in grafted skin after deep dermal and full-thickness burns.

Furthermore, the grafted skin has been shown to have a denser reinnervation with smaller, unmyelinated fibres, rather than myelinated fibres [140]. Apparently unmyelinated fibres have a greater ability to transverse scar tissue than larger myelinated fibres. These unmyelinated fibres transmit pain-related information and pruritus, which may be another explanation for why scars itch after grafting of burns, although other studies have shown that skin sensibility is decreased after deep burns [79].

A different skin problem is that in deep dermal burns not only the epidermis and peripheral nerve endings are damaged, but also all other skin appendages such as sweat and sebaceous glands. After excision of the burn, the wounds are covered with split-thickness skin grafts of about 0.25 mm thickness that usually do not include skin appendages. The resulting scars are therefore hairless and cannot produce sweat or sebum.

The skin as a psychological organ

Both the skin and the nervous system are derived from the ectoderm [53]. The skin with its dense innervation can be regarded as the body’s largest sensory organ and as both the target and source of most neuroimmunoendocrine signaling [96]. It has been estimated that for more than one third of all patients with dermatologic problems, associated emotional factors must be taken into consideration for effective treatment [48]. A field of psychodermatology has been established, which may be considered an indication of the extent to which the skin and the brain are interconnected [48, 72, 96].

Burns may cause pruritus on different levels: Firstly, the burn has direct effects associated with tissue damage, e.g. damage of sensory nerve endings in the skin and local inflammation. Secondly, the injury can be an immensely stressful psychological situation. Stressful life events have been shown to be associated with the onset of urticaria [101] and pruritus. Furthermore, the number of stressful major life events has been found to be associated with the frequency and severity of cutaneous symptoms, including itching in non-healthcare seeking individuals [49]. Furthermore, subjective rating of the intensity of pruritus may be affected by the individual’s mood [48, 101], and anxiety and depression can intensify the perception of pruritus [12].

It may therefore not be surprising that a large number of burn survivors develop pruritus and that problems can persist for many years after injury. Although a multitude of therapeutic approaches have been attempted, no single treatment has been shown to be effective in all individuals with pruritus [12], which may possibly be an indication of a broad spectrum of underlying mechanisms including social regulation [2], stress [12, 101], and tissue inflammation and regeneration [95, 96, 117].

Heat Sensitivity

Although grafted burn wounds were shown to have an increased threshold for the sensations of touch, cold, and warmth [89], many burn survivors report having problems with heat [14], and the Burn Specific Heath Scale-Brief therefore includes five items on Heat Sensitivity [68]:

- Being out in the sun bothers me
- Hot weather bothers me
- I can't get out and do things in hot weather
- It bothers me that I can't get out in the sun
- My skin is more sensitive than before

Four of the five items on Heat Sensitivity in the BSHS-B do not assess the sensation of heat in direct contact with the skin but rather discomfort during exposure to or activities in a warm environment. These problems may be based on reduced or altered sweat production in the grafted skin causing the individual to experience difficulties in regulating temperature and tolerating warm environments [122]. Furthermore, scars after deep burns will contain less melanin, so that the skin has a greater tendency to get sunburned.

Although the fifth item, "my skin is more sensitive than before", may help examine the local sensations in the damaged skin more directly, even this item reflects the effects of a thinner and less elastic skin with fewer sweat and sebaceous glands instead of a changed perception of direct contact to heat.

Although some studies on heat tolerance of burn patients have shown that individuals with burns of more than 40% of the body surface area have a reduced heat tolerance and that their body temperature increases during exercise in a warm environment, causing them to terminate exercise earlier than individuals with smaller burns and controls [11, 82, 114, 122], a more recent study showed that mild exercise in a more temperate climate was well handled even after a severe burn. [8]. Excessive, possibly compensatory, sweating in unburned areas was observed in these studies [8, 11, 122], which may nevertheless be perceived by burn survivors as a sign of heat sensitivity, even if their body temperature may not increase.

Other outcome measures: Body Image and Treatment Regimens

In addition to Heat Sensitivity, psychiatric morbidity also predicted bad outcome in two other BSHS-B domains with a combination of physical and psychological components, Body Image and Treatment Regimens. Although these domains in part assess what appear to be physical aspects of burn-related health, some items used for evaluation reflect psychological loading, e.g. “my general appearance really bothers me” (Body Image), and “there are things that I’ve been told to do for my burn that I dislike doing” (Treatment Regimens).

The concept of Body Image is linked to the subjective assessment of an individual’s own appearance and disfigurement. The results in paper V regarding Body Image are in accordance with previous studies that show that psychological factors are more important than burn size or localisation of the burn for how injured individuals rate their appearance [56, 97, 136].

Perceived bad outcome in the scale Treatment Regimens is closely linked to the perception of problems in adhering to prescribed skin care, and a general dissatisfaction with those treatment plans. It has been observed that close to half of all dermatological patients do not adhere to prescribed treatment [58, 109, 120]. Furthermore, it has been shown that psychiatric problems also decrease the adherence to dermatological treatment regimes [120]. In light of the high percentage of individuals reported in the above-cited studies who did not adhere to dermatological treatment and the results in paper V, burn patients with psychiatric morbidity should be regarded as having an increased risk of non-adherence to treatment of their scars after burns.

A large proportion of the treatment regimens prescribed after burns is targeted at improving scar quality as well as reducing pruritus [54]. Non-adherence with such treatment may therefore in itself be a risk factor for bad outcome after burns. Concurrent psychiatric problems could worsen a burn survivor’s situation, both directly by non-adherence, as well as indirectly by increasing the risk of perceiving bad outcome after burns.

Nightmares, PTSD and other psychiatric problems

In addition to the multitude of local effects of the burn on the skin, the injury with all its consequences is also the source of great stress. This increased stress is reflected in the increased frequency of nightmares compared to that in the general population, as shown in paper II. That the occurrence of nightmares is a symptom of posttraumatic stress was shown in paper III, and that it may also be a sign of the presence of PTSD was shown in paper IV.

In a study of the same population, Dyster-Aas et al. found that two thirds of all burn patients had a history of psychiatric disorders and that these individuals also had a higher risk of psychiatric problems after injury [37].

Burn patients with psychiatric problems appear to be at high risk for bad outcome and problems after burns. Another important vulnerability factor appears to be the personality trait neuroticism, which not only was shown to be associated with bad outcome, but is also known to be a risk factor for psychiatric morbidity and PTSD [16, 66].

A current and not uncontroversial hypothesis is that PTSD is not a syndrome in itself and not caused by trauma, but rather a group of non-specific symptoms in vulnerable individuals [15]. According to this approach neuroticism and psychiatric morbidity could be vulnerability factors, which could become more pronounced after stressful life events, leading to the symptoms which we currently interpret as PTSD [83]. Regardless whether there is such an entity as PTSD or whether this diagnosis is the persistence of non-specific symptoms after a traumatic event, the observation that neuroticism and psychiatric morbidity are associated with future problems in burn patients can be supported by either approach. A question for future treatment may be whether to focus treatment on the symptoms, i.e. PTSD (if there is such a thing), or the underlying condition(s), or both.

Clinical implications

In a review of the literature in 1980, Malt [80] emphasised that trauma research should focus on the identification of risk situations, risk groups, and risk reactions to trauma. Twenty years later, in 2001, two studies were published on the amount of psychological counselling and follow-up burn patients received in Europe [135, 156]. It was shown that fewer than 20% of patients received psychological counselling [135] and that only 6% had a contact with a psychologist or psychiatrist after discharge [156]. Most emotional support was given by medical staff who were not trained psychologists or psychiatrists, and by the patient's family.

These results emphasise the need for more research in this field. Short, but high-quality screening tests are needed so that "untrained" personnel can easily identify patients who are in need of referral for further investigation and treatment. Furthermore, there needs to be increased awareness of signs of psychological distress.

Although modification of personality traits may not be a primary treatment option, as they are relatively stable after adolescence [27, 34, 50, 111, 131], this observation may nevertheless be of value, as it can enable early identification of vulnerability factors or vulnerable states. Nevertheless, it has been observed that personality traits can change after treatment with antidepressants [39], which may be an indication of how psychological problems can be affected by treatment as well as an indication of how such problems can affect assessment.

Furthermore, the associations between Neuroticism and coping may present a treatment option, as coping strategies can be modified [91].

The recognition of PTSD is important with respect to prognosis. Early treatment of PTSD, possibly treatment of symptoms before the disorder is fully established, may increase the chances for remission [31]. Furthermore, treatment of PTSD-related nightmares by reduction of REM sleep has been shown to alleviate PTSD symptoms in general [115].

The observation that Heat Sensitivity, Treatment Regimens, and Body Image are associated with psychiatric morbidity is important for the follow-up of burn patients. Psychiatric morbidity can be regarded as a risk factor for perceived bad outcome or low satisfaction in these domains, which may appear to be more somatic than psychological aspects of health. This implies that it may be necessary to give treatment of psychiatric problems priority before these aspects of health can be evaluated and the need for treatment established, for example changes in skin treatment or reconstructive surgery.

Knowledge of the burn patient's psychiatric history and psychological background may enable identification of individuals who will have a tendency to perceive bad outcome and who are at risk of developing problems after injury. Investigation of these aspects should be part of routine burn care in order to individualise and focus treatment and to improve outcome after burns.

Future aspects

To understand the factors that determine outcome after a severe burn, a corresponding understanding of factors that determine and affect the healing of physical injuries, the recovery from a long stay on the intensive care unit, and the psychological return to life after the burn is required. There is currently a considerable shortage of knowledge regarding all these areas.

The healing of peripheral nerves after a burn and the mechanism of reinnervation of injured skin areas needs to be further investigated. The role of defective reinnervation, or of altered central representation for the occurrence of pruritus after a burn are two other areas that need to be approached. Another direction for further research is possible connections between itch, psychological problems and the individual experiencing of pain. The observation that there is no general, completely effective treatment for postburn itch points to the fact that key mechanisms for pruritus probably are not yet understood.

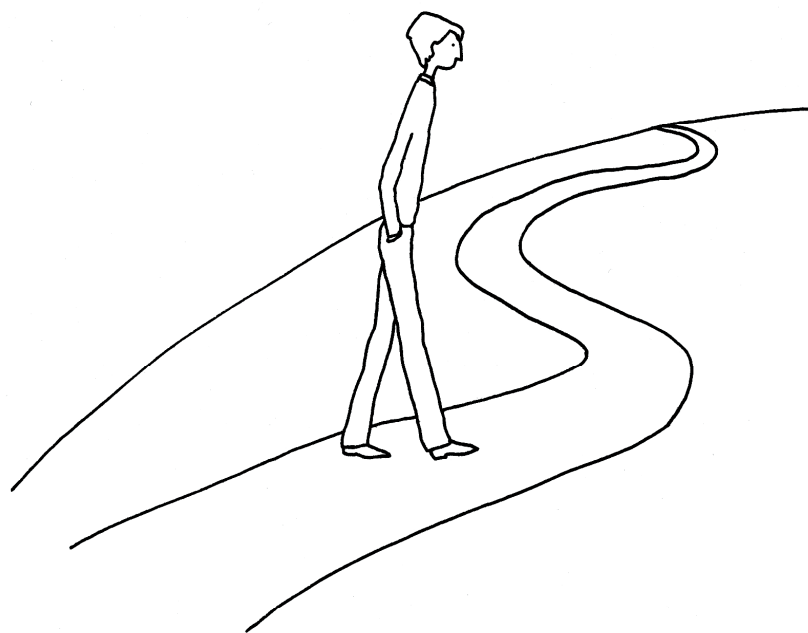
Furthermore, more information is needed on how a history of psychiatric morbidity can affect outcome after a burn regarding skin related problems. Various possible links have been discussed in this thesis, e.g. possible effects of psychiatric morbidity on non-adherence with treatment, but causal mechanisms have not been examined.

Other factors such as the trauma of a long hospitalisation after a severe burn and the necessary treatment need further investigation. Changes in treatment to reduce stress or to enhance the healing process may affect outcome in more ways than simply shortening hospitalisation.

A certain proportion of burn survivors require reconstructive plastic surgery, but a different proportion will request reconstructive plastic surgery: Even if the focus for reconstruction is initially restoration, or improvement, of function, for some patients the restoration of appearance and a subjectively “perfect body” will be the goal. One of the dilemmas in reconstructive plastic surgery is that the ideal patient is a person who is satisfied with her or his body, and therefore will often not request surgery, whereas a person who is extremely dissatisfied with her or his appearance may not be more satisfied after surgery. A possible target for treatment is the identification of individuals who will not be satisfied with reconstructive surgery. Such individuals can then be helped to become aware of this problem as well as to improve their body image.

Reasons for the considerable individual differences in how patients react both physically and psychologically to stress and injury, as well as during recovery, need to be examined.

Furthermore, rather than focusing only on problems, investigation of resilience should be an extremely interesting topic for future research: not every burn patient will develop problems. It also appears that the injury itself is not the only factor, and it is possibly not even a major factor. Why are some individuals more resilient than others, and what can we learn from them?



Conclusions

Physical and psychological problems after burns are frequent and interrelated. These factors can, together with psychiatric morbidity, affect the life and perceived health of burn survivors.

- Many burn survivors had nightmares (43%) and persistent pruritus (15%).
- The occurrence of both nightmares and pruritus decreased with time: At four years or less after injury 56% of the burn survivors had nightmares, and at 12 years or more, 33% reported nightmares. Within the same time frames, 29% and 5% had persistent pruritus.
- The factors associated with frequent nightmares were: Trait Irritability, Lack of assertiveness, size of the full-thickness burn, Reevaluation/Adjustment, gender.
- The factors associated with persistent pruritus were: Time after injury, Instrumental Action, total burn size, Lack of Assertiveness, Emotional Support.
- Psychiatric morbidity affects perceived outcome in the following six of nine burn-specific health domains: Heat Sensitivity, Treatment Regimens, Affect, Body Image, Interpersonal Relationships, and Sexuality.
- The occurrence of nightmares correlated with the amount of PTSD symptoms.
- The item “I have nightmares” can be used as a screening test for PTSD-symptomatology.
- The IES-R is an effective but overly inclusive test for the diagnosis of PTSD.

Acknowledgements

I am writing this at the end of one long journey and hopefully at the beginning of another even more exciting one. Many people have played important roles in this journey and it is quite probable that I am going to forget some I really want to mention and thank.

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The foundation for this thesis was laid during my time as a burn fellow at the Shriners Burns Hospital in Galveston, Texas. It feels as if I learnt everything there was to know (and more) about acute burn treatment, research, and writing papers there. There are so many people who mean a lot to me and whom I want to thank: I am in deep gratitude to Dr. D.N. Herndon, Dr. M. Desai, Dr. Steve Wolf and Dr. Art Sanford for teaching me - what should I say – absolutely everything! Except what Dr. R. Barrow and Dr Mike Rennie taught me about how to write papers, of course. Hey, Art, guess why I chose this title for my thesis?

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This thesis is in some ways like a piece of land around Uppsala; the deeper you dig, the more history you uncover (although I am quite sure that my thesis was not founded by the Vikings). I would not have become a fellow in Galveston if I had not been at the right place at the right time before that. My first, rather unsteady, steps in surgery, research, writing and publishing, were taken at the University Hospital in Bonn at the Departments of Surgery and Clinical Biochemistry. Here, I am greatly indebted to Professors Hirner, von Rücker and Doro Decker as well as to Dr. Marcel Kaminski, who supported me “when it all began”, and thank you to Katrin and Bernd, for giving me the courage to move on.

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