

1 **Review Article**

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3 **Management of burn wound pain in the hospital setting**

4

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29 **160 character summary of article:** Thermal injury poses a challenge to the clinician.

30 Through proper consideration of therapeutic options burn pain can be managed to aid

31 rehabilitation.

32

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34

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1 **Abstract**

2

3 In Australia, burns are common, accounting for around 5500 hospital injuries each year. The
4 proper management of burn pain is crucial to the rehabilitation process and in reducing the
5 chance of long term psychological sequelae, such as depression and post-traumatic stress
6 disorder.

7

8 A wide array of therapeutic options is available to the clinician in managing burn pain in a
9 hospital setting. These evidence-based options include opioids, non-opioid medications,
10 anxiolytics, anaesthetics, as well as relaxation techniques and cognitive behavioural therapy.

11 In managing chronic pain, therapeutic options vary between pharmacological and non-
12 pharmacological approaches used for acute pain. Consideration of these pain relief options
13 can optimise the management of patients with burns and maximise their rehabilitation,
14 leading to earlier hospital discharge.

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1 **Introduction**

2

3 Thermal injury to the skin can be one of the most painful forms of trauma [1]. In Australia,
4 burns accounted for around 5500 hospital admissions and constituted 1.2% of all injury
5 causes in 2014 [2]. The most common cause of burn injuries is contact with hot substances
6 and materials, such as fluids and cooking equipment, with the most commonly injured body
7 parts being the wrists and hands [2].

8

9 Burn pain poses a unique challenge to clinicians because its intensity varies greatly between
10 patients and the perception of pain fluctuates over the course of a patient's admission [3].
11 Furthermore, there is currently limited evidence on management of burns injury. Current
12 treatment is based on data extrapolated from several randomised clinical trials, case series
13 and reports, and relevant areas of pain medicine [4]. This type of pain can also be
14 unpredictable and depends on anatomical, physiological, psychological, and premorbid
15 behavioural factors [2]. Distinctive to burn injury is the notable link to psychological harm.
16 Burn wounds are associated with disorders such as acute stress disorder, depression, suicidal
17 ideation, and post-traumatic stress disorder for as long as two years after the initial injury [5].
18 Moreover, insufficient management of burn pain itself has been associated with a range of
19 diseases and loss of patient confidence, which can complicate treatment and slow
20 rehabilitation. Inadequately managed pain can also limit patient mobilisation and thereby
21 limit physiotherapy that can cause prolonged hospital stays and hospital acquired infections
22 [6,7]. This relationship has been documented in the literature with burn pain being a stronger
23 predictor, rather than the size of the burn or the length of hospitalisation, of psychological
24 adjustment [8]. It is because of this that the management of pain in patients suffering from
25 burn injuries should be carefully considered in order to maximise recovery.

26

27 A number of Australian guidelines exist for burn injuries, including those by the New South
28 Wales (NSW) State-wide Burn Injury Service, Australian Pain Management Association,
29 Australian and New Zealand Burn Association, The Royal Children's Hospital and The
30 Royal Australian College of General Practitioners. The aim of this review is to assess the
31 available literature in order to provide a comprehensive review of evidence-based approaches
32 to managing burn pain in a hospital setting.

1 **Methods**

2

3 In November 2017, a systematic search of the PubMed, Cochrane, and UpToDate databases
4 was conducted using combinations of keywords such as “burn”, “thermal injury”, “pain”,
5 “hospital”, “analgesia”, and “management” to identify available data sources. Only studies in
6 English were included in the review. Selection criteria for the review included academic
7 articles from peer-reviewed journals and evidence-based clinical resources, such as
8 UpToDate and BMJ Best Practice.

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1 **Managing initial acute pain**

2
3 The instant pain that follows a burn injury is due to the stimulation and damage of skin
4 thermoreceptors, mechanoreceptors, and a selection of exogenous and endogenous mediators
5 [7]. Nerve endings that are entirely destroyed will not transmit pain, but those that remain
6 undamaged and exposed will generate pain throughout the time and course of treatment, a
7 response termed primary hyperalgesia [7]. Furthermore, damaged and regenerating nerve
8 tissues can give rise to complex neuropathic pain syndromes, whereby the sensation of the
9 painful stimulus outlives its expected duration [1]. Other symptoms characteristic of
10 neuropathic pain include tingling, stiffness, cold or hot pain, as well as itching [1].

11
12 Pain assessment is an important component of pain care and should be assessed regularly.
13 Evidence-based scores include the Verbal Numerical Rating Score, a score from 0 to 10
14 ranked from no pain to the worst pain possible [9]. Also useful is the Wong-Baker FACES®
15 Pain Rating Scale, which uses visual faces to represent pain and is useful if patients have
16 difficulty quantifying their pain numerically [9].

17
18 First-aid management of burns include cooling the area with tepid or cold water for 20
19 minutes, which may terminate the burning process and reduce the pain of the injury [3,4,6].
20 Elevation of the injured part and the application of a compressive dressing, or oedema gloves
21 in the case of hand burns, can help reduce oedema and can minimise the development of pain
22 associated with swelling and stiffness [4,6,10]. Immediate and effective analgesia medication
23 should be provided. Rapid options include intranasal fentanyl or intravenous (IV) morphine
24 [3]. Non-steroidal anti-inflammatory (NSAID) medications may be useful as adjuncts to
25 opioids or used alone to manage small burn injuries [7].

26 **Managing burn pain in the hospital**

27
28
29 There are different types of pain experienced by burn patients in the hospital, for which
30 adequate analgesia strategies should be considered. These range from background pain,
31 which is continuous and present at rest, procedural pain evoked during dressing removal and
32 cleaning, as well as emotional and psychological pain experienced by the individual [11,12].
33 While pharmacological and non-pharmacological methods exist for managing burn pain, a
34 multimodal approach to pain management has provided good results in controlling pain while
35 minimising the patients' risk of experiencing side effects [1]. Strategies that utilise pre-
36 emptive regular dosing with supplemental prescriptions for breakthrough pain are most
37 effective in practice [1].

38
39 During the transition from acute burn injury to burn healing, burns can contract and be a
40 source of pain to patients [13]. It is important, therefore, that pre-emptive pain control is
41 utilised to ensure adequate allied health support can be provided, ideally from the day of
42 patient admission into hospital [10]. For example, stretching injured tissue during
43 physiotherapy or occupational therapy in the hospital setting is vital to optimise burn
44 recovery and support return of function [10,18]. Inadequate pre-emptive pain control
45 jeopardises the crucial role these allied health service have in the rehabilitation process,
46 increasing the risk of scarring and contractures [10,14].

47
48 Pharmacological pain management options include opioid analgesics, non-opioid analgesics,
49 anxiolytics, and anaesthetics (Table 1). The type of medication used is determined by the
50 severity of the pain, anticipated duration of the pain and availability of intravenous access.

1 These medications have variable durations of action and should be titrated to meet the needs
2 of the patient in each clinical setting [3]. In order to control background pain associated with
3 burns, it is recommended to aim for near constant plasma levels of regularly scheduled
4 analgesics, such as long-acting analgesics, non-opioid analgesics, or long-acting IV opioid
5 infusions in patients unable to take oral medications [3]. Guidance from a pain specialist
6 should be sought early and can guide the implementation of a multimodal pain strategy.

8 **Pharmacological Pain Management**

10 *Opioid analgesics*

11 Opioids are a mainstay option for the treatment of burn pain, especially in the acute phase
12 [17]. They are also the most efficacious medication in perioperative moderate and severe pain
13 management [17]. Opioids can be delivered via a variety of routes, including oral,
14 intravenous, transdermal, sublingual and rectal routes. It is available in short or long-acting
15 formulations [17]. In the initial presentation of severe burns, analgesia is best achieved by
16 titration of IV opioids, as other routes may be less reliable in the presence of hypovolaemia
17 and vasoconstriction associated with burns [4]. For acute burn injuries, patient-controlled
18 analgesia (PCA) with IV morphine can be considered. It offers the burn patient a safe and
19 effective method of achieving flexible analgesia, provided the patient is alert and competent
20 enough to use the device [4]. For breakthrough pain during the acute phase or healing phase,
21 short-acting potent opioids should be used and can be titrated to effect by increasing the dose
22 while maintaining the dosing interval [15]. For example, short-acting opioids such as fentanyl
23 can provide good analgesia during dressing changes when administered via target-controlled
24 IV infusions of PCA [4]. During the acute phase, controlled release or long half-life opioids,
25 such as methadone, can be effective for background pain when administered by clinicians
26 trained in its use [13,16]. Side effects are common with opioids, with some studies finding
27 that up to 92% of patients experience at least one side effect, such as constipation, nausea,
28 respiratory depression, or sedation [17]. Prophylactic antiemetics and aperients should be
29 considered when opioids are given [8].

31 *Non-opioid analgesics*

32 Paracetamol and NSAIDs provide mild analgesia and can supplement opioids. Paracetamol
33 and NSAIDs exhibit a ceiling effect in their dose-response relationship, rendering them
34 unsuitable as single agents for the treatment of severe burn pain, but they can be effective as
35 adjuvants to opioid medications for background pain [18]. Care should be taken when using
36 NSAIDs in older patients and in patients with renal impairment or gastric injury. While
37 NSAIDs are effective against inflammatory pain, their use should not be recommended in
38 patients with significant burns who are at an increased risk of renal failure [19].

39
40 Other non-opioid medications which have been shown to be useful in controlling acute pain
41 are neuropathic agents, such as antidepressants and anticonvulsant agents [20].
42 Antidepressant medications, such as tricyclic antidepressants, can enhance opioid analgesia,
43 especially in patients with chronic pain [20]. Also, there is evidence that anticonvulsant
44 agents, such as pregabalin and gabapentin, can be used to reduce pain following acute burn
45 injury, with gabapentin use being associated with reduced opioid usage [4,21]. The use of
46 pregabalin or gabapentin should be considered by clinicians as a part of multimodal analgesia
47 for patients suffering from neuropathic pain after acute burns injury [4,21].

48 49 *Anxiolytics*

1 Anxiolytic medications are commonly used in burn units to reduce patient anxiety before or
2 during procedures, such as debridement and to reduce the exacerbation of pain [2]. Studies
3 have shown that benzodiazepine therapy can improve post-procedural pain scores in burn
4 patients, although one recent study investigating this found the effect to only be significant in
5 those with high baseline pain [22]. The benzodiazepine midazolam may be useful for its
6 dissociative, anxiolytic, and sedative qualities and may help reduce pain in patients
7 undergoing dressing changes or wound cleaning [11].

8 9 *Anaesthetics*

10 A range of anaesthetics have a role in the management of burn pain if used under the
11 guidance of a trained clinician such as an anaesthetist [3,4]. General anaesthesia or deep
12 sedation with anaesthetic agents, such as propofol, may be considered for patients undergoing
13 intensely painful procedures, such as large dressing changes [3,4]. Also, the inhaled agent
14 nitrous oxide can be useful during short, moderately painful procedures, typically as a 50%
15 mixture in 50% oxygen [3,10]. This can be self-administered by an awake, cooperative and
16 spontaneously breathing patient via a mouthpiece or mask [3]. The anaesthetic agent
17 ketamine can have potent analgesic effects when administered at subanaesthetic doses and
18 can be used to facilitate procedures such as dressing changes [4]. Ketamine induces a
19 dissociative state with a fast onset of action and distressing psychomimetic symptoms [1,10].

20 21 **Non-pharmacological pain management**

22 23 *Relaxation techniques*

24 Relaxation techniques are used to lower arousal, including unnecessary muscle tension that
25 can increase pain, particularly during dressing changes and debridement [1]. Techniques that
26 have been shown to be useful include deep breathing, progressive muscle relaxation and
27 music interventions [1,22]. One quasi-experimental study of 64 burn patients investigating
28 abdominal breathing exercises found a significant reduction in pain scores compared to the
29 control group [22]. This effect may be dependent on the technique of relaxation; however, a
30 separate study investigating jaw relaxation techniques did not detect a significant difference
31 in pain intensity [23].

32 33 *Cognitive behavioural therapy (CBT)*

34 These techniques include diversion, information provision, coping skills, and relaxation
35 techniques that modify the patient's thought process about painful experiences [24].
36 Catastrophising pain can increase levels of perceived pain and CBT aims to reduce these
37 perceptions and provide control to the patient in their pain management [25]. CBT has been
38 shown to be an effective pain control technique in treating procedural pain [19,25]. While its
39 use for the hospitalised burn patient has not been explored in the literature, evidence does
40 highlight its utility in reducing anticipatory pain and distress, reducing catastrophic thinking
41 during procedures and assisting to distract from pain by diverting attention [26].

42 43 **Chronic burn pain**

44
45 Damage inflicted by burns can cause a range of chronic pain syndromes in patients. Studies
46 have found that chronic burn pain is a significant problem, with one study in the United
47 States finding 52% of burn patients had ongoing pain around 12 years after injury [15]. This
48 can significantly affect the patient's rehabilitation by affecting sleep, impairing performance
49 and resulting in depressive symptoms [1]. General advice for the management of chronic pain
50 involves consideration of the principles of multimodal analgesia with support from

1 interdisciplinary team members [23]. In the management of chronic burn pain, conventional
2 analgesics, such as opioids, have a lesser role and should be monitored diligently for ongoing
3 benefit and adverse outcomes [1,22]. Treatment with antidepressants, such as amitriptyline,
4 and anticonvulsants, such as pregabalin and gabapentin, also have a role in controlling
5 neuropathic pain and reducing opioid requirements [1,15].
6

7 When considering non-pharmacological treatment options, there is some evidence to suggest
8 CBT and hypnosis therapy can assist in management of pain [1,3,4]. Hypnosis has been well
9 described in conjunction with conventional analgesic medication, with case reports
10 suggesting synergistic and stand-alone effects in patients undergoing burn dressing changes
11 [1,3]. In cases of resistant chronic pain, patients should be referred to a pain specialist for
12 ongoing management.

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1 **Conclusion**

2

3 The effective management of pain after a burn injury is essential in the acute hospital setting,
4 as well as in the subsequent program of rehabilitation. Burn injury pain is a common medical
5 problem, for which many therapeutic management options exist. This review has highlighted
6 a range of currently used evidence-based therapeutic options. A multimodal analgesic plan
7 should consider options such as opioid and non-opioid analgesics, anaesthetics, anxiolytics,
8 as well as relaxation techniques and CBT as required. Input from a pain specialist should be
9 sought early in cases of both acute and chronic burn pain.

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1 **References**

2
3 [1] Norman A, Judkins K. Pain in the patient with burns. *BJA Education*. 2004;4(2):57-61.
4 doi:10.1093/bjaceaccp/mkh016

5
6 [2] Australian Government: Australian institute of Health and Welfare. Hospitalised burn
7 injuries Australia 2013-2014. *Injury Research and Statistics Series*. 2017;102. Available
8 from: [https://www.aihw.gov.au/getmedia/aa910281-ad80-4963-808e-](https://www.aihw.gov.au/getmedia/aa910281-ad80-4963-808e-c41bc7191039/20432.pdf.aspx?inline=true)
9 c41bc7191039/20432.pdf.aspx?inline=true

10
11 [3] Wiechman S, Shararar S. Management of burn wound pain and itching. 2017 [Internet].
12 Uptodate. Available from: [https://www.uptodate.com/contents/management-of-burn-wound-](https://www.uptodate.com/contents/management-of-burn-wound-pain-and-itching)
13 pain-and-itching

14
15 [4] Australian and New Zealand College of Anaesthetists and Faculty of Pain Medicine.
16 Acute Pain Management: Scientific Evidence. Fourth Ed 2015. Available from:
17 <http://fpm.anzca.edu.au/resources/professional-documents>

18
19 [5] Dalal P, Rahul S, Agarwal M. Psychiatric aspects of burn. 20. *Indian J Plast Surg*. 2010;
20 43(Suppl): S136-42. doi:10.4103/0970-0358.70731

21
22
23 [6] Royal Australian College of General Practitioners: Australian Family Physician.
24 Emergency Care: Thermal Burns. *AFP*. 2012; 41(6):372-5. Available from:
25 <https://www.racgp.org.au/afp/2012/june/thermal-burns-assessment-and-acute-management/>
26

27 [7] Latarjet J, Choinere M. Pain in burn patients. 1995 [Internet]. *Burns*. doi:10.1016/0305-
28 4179(95)00003-8

29
30 [8] Australian Pain Management Association. Burns Pain. 2017. The Australian Pain
31 Management Association. Available from: [https://www.painmanagement.org.au/using-](https://www.painmanagement.org.au/using-joomla/extensions/components/content-component/article-category-list/217-burns-pain.html)
32 joomla/extensions/components/content-component/article-category-list/217-burns-pain.html

33
34 [9] Victorian Adults Burns Service: Alfred Hospital. Pain Management. Burns Management
35 Guidelines. 2017. Available from: [http://www.vicburns.org.au/minor-burns/minimise-](http://www.vicburns.org.au/minor-burns/minimise-infection/pain-management-1/)
36 infection/pain-management-1/
37

38 [10] Castro R, Leal P, Sakata R. Pain management in burn patients. *Rev. Bras. Anesthesiol*.
39 2013;63(1). doi:10.1590/S0034-70942013000100013

40
41 [11] Edgar D, Brereton M. Rehabilitation after burn injury. *ABC of burns*. 2004; 329-43.
42 doi:10.1136/bmj.329.7461.343

43
44 [12] Browne A, Andrew R, Schug S, Wood F. Persistent pain outcomes and patient
45 satisfaction with pain management after burn injury. *Clin J Pain*. 2011;27(2):136-45.

- 1 [13] Summer G, Puntillo K, Miaskowski C, Green P, Levine J. Burn injury pain: the
2 continuing challenge. *J Pain*. 2007;8(7):553-48.
3
- 4 [14] James D, Jowza M. Principles of Burn Pain Management. *Clin Plast Surg*. 2017;
5 44(4):737-47. doi:10.1016/j.cps.2017.05.005
6
- 7 [15] Dauber A, Osgood P, Breslau A, Vernon H, Carr D. Chronic persistent pain after severe
8 burns: a survey of 358 burn survivors. *Pain Med Oxford*. 2002;3(1):6-17. doi:
9 10.1046/j.1526-4637.2002.02004.x
10
- 11 [16] Rowan M, Cancio L, Elster E, Burmeister D, Rose L, Natesan S, Chan R, Christy R,
12 Chung K. Burn wound healing and treatment: review and advancements. *Crit Care*. 2015;
13 19(243). doi:10.1186/s13054-015-0961-2
14
- 15 [17] Richardson P, Mustard L. The management of pain in the burns unit. *Burns*. 2009;
16 35(7):932-36. doi:10.1016/j.burns.2009.03.003
17
- 18 [18] Bittner E, Shank E, Woodson L, Martyn J. Acute and perioperative care of the burn-
19 injured patient. *Anesthesiology*. 2015;122(2):448-64. doi:10.1097/ALN.0000000000000559
20
- 21 [19] Gray P, Kirby J, Smith M, Cabot P, Williams B, Doecke J, Cramond T. Pregabalin in
22 severe burn injury pain: a double-blind randomised placebo-controlled trial. 2011;
23 152(2011):1279-88. doi:10.1016/j.pain.2011.01.055
24
- 25 [20] Patterson D, Ptacek J, Carrougher G, Sharar S. Lorazepam as an adjunct to opioid
26 analgesics in the treatment of burn pain. *Pain*. 1997;72(3):367-74. Available from:
27 <https://www.ncbi.nlm.nih.gov/pubmed?term=9313277>
28
- 29 [21] Morgan M, Deuis J, Frosig-Jorgensen M, Lewis R, Cabot P, Gray P, Vetter I. Burn Pain:
30 A systematic and critical review of epidemiology, pathophysiology and treatment. *Pain Med*.
31 2017;0:1-27. doi:10.1093/pm/pnx228.
32
- 33 [22] Park E, Oh H, Kim T. The effects of relaxation breathing on procedural pain and anxiety
34 during burn care. *Burns*. 2013; 39(6):1101-6. doi:10.1016/j.burns.2013.01.006
35
- 36 [23] Forough R, Fahimeh M, Roohangiz O. Effectiveness of jaw relaxation for burn dressing
37 pain: randomized clinical trial. *Pain Manag Nurs*. 2014;15(4):845-53.
38 doi:10.1016/j.pmn.2013.11.001
39
- 40 [24] Wiechman S. Psychosocial aspects of burn injuries. *BMJ*. 2004;329(7462):391-93.
41 doi:10.1136/bmj.329.7462.391
42
- 43 [25] Thurber C, Martin-Herz, Paterson D. Psychological principles of burn wound pain in
44 children. I: theoretical framework. *J Burn Care Rehabil*. 2000;21(4):376-87.
45

- 1 [26] Li J, Zhou L, Wang Y. The effects of music intervention on burn patients during
2 treatment procedures: a systematic review and meta-analysis of randomized controlled trials.
3 BMC Complement Altern Med. 2017;17:158. doi: 10.1186/s12906-017-1669-4
4
- 5 [27] Yang Cm Xiao-min X, Guang-Zhao H. Efficacy and feasibility of opioids for burn
6 analgesia: An evidence-based qualitative review of randomized controlled trials. Burns. 2017;
7 44(2):241-48. doi: 10.1016/j.burns.2017.10.012
- 8 [28] Rovers J, Knighton J, Neligan P, Peters W. Patient-controlled analgesia in burn patients:
9 a critical review of the literature and case report. Hosp Pharm. 1994;29(2):106, 108-11.
10
- 11 [29] Meyer W, Nichols R, Cortiella J, Villarreal C, Marvin J, Blakeney P, Herndon D.
12 Acetaminophen in the management of background pain in children post-burn. J Pain
13 Symptom Manage 1997;13(1):50-5.
14
- 15 [30] Patterson D, Ptacek J, Carrougher G, Sharar S. Lorazepam as an adjunct to opioid
16 analgesics in the treatment of burn pain. Pain. 1997;72(3):267-74. Available from:
17
- 18 [31] McGuinness S, Wasiak J, Cleland H, Symonds J, Hogan L, Hucker T, Mahar P. A
19 systematic review of ketamine as an analgesic agent in adult burn injuries. Pain Medicine.
20 2011;12(10): 1551-8. doi: 10.1111/j.1526-4637.2011.01220.x
21
- 22 [32] Forough R, Fahimeh M, Roohangiz O. Effectiveness of jaw relaxation for burn dressing
23 pain: randomized clinical trial. Pain Manag Nurs [Internet]. 2014;15(4):845-53. doi:
24 10.1016/j.pmn.2013.11.001
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1 **Tables**

2

3 ***Table 1. Pain management options for burn pain in the hospital setting.***

Pain management options for burn pain in the hospital setting	Level of evidence available
Pharmacological	
Opioids	I [27-28]
Non-opioids (paracetamol, non-steroidal anti-inflammatory drugs)	Paracetamol - III-2 [29]
Anxiolytics (midazolam)	I [30]
Anaesthetics (ketamine, nitrous oxide, propofol, sevoflurane)	Ketamine – II [31]
Non-pharmacological	
Relaxation techniques	III-1[32]

4

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