Evidence summary: Wound management: tea tree oil

June 2013

Author

Wound Healing and Management Node Group

QUESTION

What is the best available evidence regarding the effectiveness of tea tree oil preparations used for managing wounds?

CLINICAL BOTTOM LINE

Tea tree oil (TTO) is an essential oil traditionally used for its antibacterial and anti-inflammatory properties. It is for topical use only. Despite a range of evidence on its effectiveness in managing common skin conditions (for example, dermatitis, acne and tinea) and *in vitro* studies demonstrating its activity against bacteria, fungi and herpes simplex virus, there is minimal literature reporting its effectiveness in promoting healing in wounds[1]. Clinical studies suggest there may be a role for 1% to 10% TTO in promoting wound healing[2-7]. Although *in vitro* studies[1,8-10] have shown effectiveness in inhibiting bacterial growth, clinical trials[4,5] conducted to date have not supported this finding; however, the in-vivo evidence is limited.

Tea tree oil is an essential oil derived from an Australian native plant, *Melaleuca alternifolia*, which is available as an over-the-counter topical preparation. Although the oil has over 100 active components, its formulation is regulated by international standards organisations who define the chemical composition required for the 14 primary components[1,11]. Tea tree oil preparations (for example, gel, lotion or ointment) have been used as a natural treatment for superficial skin conditions including insect bites, head lice, dandruff and fungal infection of the skin or nails[11]. Clinicians report using TTO in wound management to facilitate wound debridement, reduce local inflammation and as an antimicrobial[7].

(Note: Tea tree oil is not the same as eucalyptus oil.)

Effectiveness in promoting healing

- A small RCT (n=10) found a TTO dressing (concentration not stated) was more effective at promoting healing than a saline dressing (p=0.013). Healing was assessed as reduction in surface area over 10 days[5]. (Level II)
- In one uncontrolled trial (n=12) 3.3% TTO used as a wound cleansing solution was associated with a reduction in wound size for 8 participants (prior to their withdrawal from the study in order to commence antibiotic therapy)[4]. (Level III)
- A series of case studies (n=3) reported use of a hydrogel dressing containing 4% TTO to manage Stage IV pressure injuries, necrotic ulcers and wounds requiring surgical debridement and closure. Dressings were changed daily to fifth daily determined by the depth of the wound. All wounds were described as healing well with no maceration to peri-wound skin; however, a range of additional wound management strategies were also employed and no objective outcome measures were reported[7]. (Level III)
- A series of case studies (n=10) reported the effectiveness of a water-based TTO preparation applied as a spray three times daily (3mg daily) to gangrenous lower limb wounds requiring split skin grafting (SSG). The patients had diabetes mellitus and vascular insufficiency. In all cases granulation occurred within 2 to 3 weeks to a stage that enabled grafting. The TTO treatment was continued for 1 to 2 weeks following SSG[6]. (Level III)
- In one case study a chronic non-healing post-amputation surgical wound packed daily with 10% TTO and 90% pumpkin seed oil completely healed after approximately five months of treatment. The wound had been unexpected to heal without surgery[3]. (Level III)
- In one case study fracture blisters achieved epithelialisation within 10 days when treated daily with a propylene glycol gel consisting of >90% purified water and 4% TTO, together with a non-adherent dressing. The report compares this to a usual healing time of 18 to 21 days observed for fracture blisters treated with silver sulfadiazine (SSD) cream and a non-adherent dressing[2]. (Level III)

Effectiveness in managing wound infection

Evidence from clinical studies

- A small RCT (n=10) compared TTO dressing to a saline dressing for managing MRSA in wounds of an undefined type. There was no significant difference (p=0.122) between the two groups in MRSA bacterial burden evaluated via wound swab over a 10 day treatment period[5]. (Level II)
- In one uncontrolled trial (n=12) TTO at 3.3% concentration used as a wound cleansing solution (either daily or 3 times per week for up to 3 months) failed to eradicated MRSA in any of the mixed-aetiology wounds. Of the 12 participants, 7 withdrew from the study due to commencement of antibiotics and only 2 completed the full trial[4]. (Level III)

Evidence from laboratory studies

- A comprehensive literature review[1] reported findings from 17 *in vitro* studies published prior to 2006 on the anti-bacterial characteristics of TTO. A wide range of bacteria, including *E. coli, K. pneumoniae, S. epidermidis, S. aureus* (including antibiotic resistant strains) and *S. pyogenes* have

been demonstrated to have susceptibility to TTO at 1 to 2% concentration. In addition, the review reports 13 *in vitro* studies demonstrating anti-fungal activity and two studies that found anti-viral (for example, herpes simplex virus) activity. (Level IV)

- Additional *in vitro* studies published post-2006 provide further support for an anti-bacterial effect of TTO:
  - One study that used an agar medium found TTO combined with 0.2% benzethonium chloride and other essential oils was superior in eradicating *S. aureus* strains over 24 hours compared with a saline control ($p<0.05$) and compared with neomycin 3.5mg/g combined with polymyxin B ($p<0.05$)[8]. (Level IV)
  - One *in vitro* study compared a range of TTO products (concentrations from 0.1% to 15% including formulated and non-formulated products). Solid TTO products were tested on agar plate assay and liquid TTO products were tested in broth assay. Non-formulated TTO products achieved bacterial inhibition (*S. aureus, P. aeruginsa, E. coli, C. albicans)* similar to those reported in other literature[1]. Efficacy of formulated products related to method of testing (agar plate versus broth). Although levels of alcohol and surfactants in a TTO formulation may influence the antibacterial effect of the product, all products maintained adequate antimicrobial activity[10]. (Level IV)
  - An additional *in vitro* study investigated the minimum inhibitory concentration (MIC) of TTO for MRSA strains. MIC for 90% of organisms was 0.5%[9]. (Level IV)

Effectiveness in managing biofilm

- One *in vitro* study found that TTO was effective in decreasing MRSA biofilm activity. After 120 minutes, biofilm activity in samples exposed to 0.5% TTO was 40% of that observed in controls. Biofilm activity was 15% of that observed in controls for samples exposed to 1% TTO. Further research is required to determine if there is a sustained effect or ability to completely eradicate biofilm[9]. (Level IV)

ADVERSE EFFECTS AND CONTRAINDICATIONS

Irritation and allergic response

Tea tree oil applied to intact skin

- A comprehensive literature review[1] reported two studies (total n=528) in which patch testing established none to mild irritant reactions in TTO preparations in concentrations

of between 10% and 100% applied to healthy volunteers. (Level III)

- A second literature review[11] reports seven patch testing or clinical studies that found irritant responses to 1% TTO at rates of 0 to less than 1% of participants (in total over 2,000 participants). In one study in which TTO at 25% concentration was used, 10% of the 28 patients had a sensitivity reaction[11]. (Level III)

Tea tree oil applied to broken skin (rashes) or wounds

- A literature review[1] reports 10 RCTs in which TTO (concentrations of 5% to 100%) was used to treat common skin conditions (for example, dermatitis, acne, tinea). Mild irritation was reported as an adverse event in five of these trials, but only occurred at a significantly higher rate than the control treatments (placebo gels and 1% clotrimazole) in one trial (5% TTO versus 5% benzoyl peroxide gel, p<0.001). (Level II)
- In most case studies in which TTO was applied directly to wounds, no adverse effects were observed[2,3,6,7]. (Level III)

OTHER CONSIDERATIONS

Odour management

- In case studies, patients and staff members reported 4% TTO wound products to have a pleasant odour when applied to fracture blisters[2], pressure injuries[7] and wounds requiring surgical debridement and closure[7]. (Level III)
- In a laboratory-based study, the effectiveness in reducing odour of a TTO impregnated non-woven fabric was compared to aloe vera gel and activated charcoal dressings. TTO was less effective in reducing malodour (mean time to detect diethylamine volatiles 2mins 54secs for TTO versus >23 minutes for aloe vera and for charcoal, p=not stated)[12]. (Level III)

Ease of use

- In a series of case studies a hydrogel dressing containing 4% TTO was reported to be easy to apply in conjunction with gauze or a non-adherent dressing for both superficial and cavity wounds[7]. (Level III)

Cost-effectiveness

- One series of case studies (n=3) in an Australian tertiary hospital suggested a hydrogel dressing containing 4% TTO is a cost-effective wound management option compared with traditional hydrogels. Cost savings were reported to arise from reduced dressing material cost, less frequent wound dressing changes and reduced nursing time. No objective outcomes were reported[7]. (Level III)
- A series of case studies reported that TTO spray was a cost-effective management strategy in an Australian tertiary hospital setting[6]. (Level III)

CHARACTERISTICS OF THE EVIDENCE

This evidence summary is based on a structured literature and database search combining search terms that describe wound management and tea tree oil. The evidence in this summary comes from:

- One pilot RCT of small size that does not report confidence intervals[5]. (Level II)
- One uncontrolled clinical trial[4]. (Level III)
- *In vitro* studies and laboratory-based studies[8-10,12]. (Level IV)
- Case reports[2,3,6,7]. (Level III)
- Two literature reviews[1,11] reporting findings from RCTs (Level II), case studies (Level III) and *in vitro* studies (Level IV).

BEST PRACTICE RECOMMENDATIONS

- There is some evidence that TTO could be used to promote wound healing. (Grade B)
- There is some evidence that TTO could be used effectively as a topical antibacterial in wound management. (Grade B)

REFERENCES

1. Carson C, Hammer K & Riley T. Melaleuca alternifolia (tea tree) oil: a review of antimicrobial and other medicinal properties. Clin Microbiol Rev 2006; 19(1):50–62. (Level IV review reporting Level II and Level III studies)
2. Cox H & Nealon L. The use of Burnaid Gel™ on fracture blisters. Wound Practice and Research 2008; 16(1). (Level III)
3. Culliton P. Chronic Wound Treatment With Topical Tea Tree Oil. Altern Ther Health Med 2011; 17(2):46–7. (Level III)
4. Edmondson M, Newall N, Carville K, Smith J, Riley T & Carson C. Uncontrolled, open-label, pilot study of tea tree (Melaleuca alternifolia) oil solution in the decolonisation of methicillin-resistant *Staphylococcus aureus* positive wounds and its influence on wound healing. Int Wound J 2011; 8:375–84. (Level III)
5. Lee R. Tea tree oil dressing. Sigma Theta Tau International, 23rd International Nursing Research Congress, Honor Society of Nursing, 30 Brisbane, Australia 2012. (Level II)
6. Sherry E, Sivananthan S, Warnke P & Eslick G. Topical phytochemicals used to salvage the gangrenous lower limbs of type 1 diabetic patients. Diabetes Res Clin Pract 2003; 62:65–6. (Level III)
7. Webber L. Managing bio-burden and devitalised tissue: an early intervention using Woundaid®. Wound Practice and Research 2011; 19(3):174–279. (Level III)
8. Bearden D, Allen G & Christensen J. Comparative *in vitro* activities of topical wound care products against community-associated methicillin-resistant *Staphylococcus aureus*. J Antimicrob Chemother 2008; 62:769–72. (Level III)
9. Kwiecinski J, Eickb S & Wójcika K. Effects of tea tree (Melaleuca alternifolia) oil on *Staphylococcus aureus* in biofilms and stationary growth phase. Int J Antimicrob Agents 2009; 33:343–7. (Level III)
10. Thomsen P, Jensen T, Hammer K, Carson C, Mølgaard P & Riley T. Survey of the antimicrobial activity of commercially available Australian tea tree (Melaleuca alternifolia) essential oil products *in vitro*. J Altern Complement Med. 2011; 17(9):835–41. (Level III)
11. Halcón L & Milkus K. *Staphylococcus aureus* and wounds: A review of tea tree oil as a promising antimicrobial. Am J Infect Control. 2004; 32(7):402–8. (Level IV)
12. Lee G, Anand S & Rajendran S. Are bioploymers potential deodourising agents in wound management? J Wound Care 2009; 18(7):290–5. (Level III)