Aim. The purpose of this study was to examine the efficacy of silver-releasing dressings in the management of non-healing chronic wounds.

Background. Non-healing chronic wounds often have a negative physical impact on patients and place a financial burden on healthcare systems. Silver dressings are wound products designed to control infection and provide a wound environment conducive to healing. However, validation of the clinical efficacy of these dressings is lacking.

Design. Systematic review and meta-analysis.

Methods. A systematic search of the major electronic databases PubMed, CINAHL, Cochrane, MEDLINE, British Nursing Index, EBSCO, OCLC and Proquest between 1950–June 2007 was conducted. Hand searches of selected periodicals, textbooks and checking reference lists and contacting experts was also performed.

Results. Eight studies were selected from a potentially relevant 1957 references screened. Analysis incorporated data from 1399 participants in the eight randomised control trials. We found that silver dressings significantly improved wound healing (CI95: 0.16–0.39, \( p < 0.001 \)), reduced odour (CI95: 0.24–0.52, \( p < 0.001 \)) and pain-related symptoms (CI95: 0.18–0.47, \( p < 0.001 \)), decreased wound exudates (CI95: 0.17–0.44, \( p < 0.001 \)) and had a prolonged dressing wear time (CI95: 0.19–0.48, \( p = 0.028 \)) when compared with alternative wound management approaches. An analysis of sensitivity in these studies by subgroup analysis generally supported these associations. Furthermore, studies indicated an improvement in quality of life (CI95: 0.04–0.33, \( p = 0.013 \)) using silver dressings in wound management with no associated severe adverse events.

Conclusion. This meta-analysis confirms the effectiveness of silver dressings in wound healing and improving patients’ quality of life. However, it also highlights the need for additional well-designed randomised controlled trials to evaluate the effectiveness of silver-related dressings further.

Relevance to clinical practice. The results of this study provide objective data on the effectiveness of silver-related dressing when applied to non-healing chronic wounds.

Key words: clinical effectiveness, meta-analysis, nurses, nursing, review, wound care
Introduction

Non-healing chronic wounds are a serious health issue: they cause great pain and suffering to patients impacting on their quality of life and place a significant financial burden on health systems.

A recent innovative concept in chronic wound care is represented by the ‘wound bed preparation’ model proposed by Sibbald et al. (2001) who identifies four main strategies to good wound bed preparation; specifically, tissue management, infection and inflammation control, moisture balance and edge of wound care (Sibbald et al. 2001, Moffatt 2004, Fletcher 2005). When the wound bio-burden exceeds a host-manageable level, a wound may become infected. Chronic infection is clearly detrimental to wound healing (Tomaselli 2006). Non-healing chronic wounds, e.g. pressure ulcer, venous ulcer, arterial ulcer and diabetic ulceration, are usually contaminated with several species and the progression to local infection occurs in stages, often leading to critical colonisation (Ayello & Cuddigan 2004, Giulio & Barrett 2005). When this occurs and host response is reduced, the normal wound healing process is interrupted because of a prolonged inflammatory response, molecular and cellular abnormalities in the wound bed and granulation tissue breakdown resulting in a non-healing and deteriorating wound (Giulio & Barrett 2005, Gray et al. 2006). Appropriate management of infected and critically colonised wounds is essential to encourage wound healing progression (Bowler 2003). Treatment of infected wounds should focus on the removal of dead or necrotic tissues and the management of wound exudates (Schultz et al. 2003, Ayello & Cuddigan 2004). Unfortunately, not only there are difficulties in diagnosing critical colonisation or infection, but traditional topical antimicrobials can be toxic to granulation tissues or increase the chance of resistant organisms. It is possible, however, to reduce the wound bio-burden and avoid systemic infection by silver-releasing wound dressings (Gray et al. 2006, White & Cutting 2006).

Silver, in its common ionic (active) form (Ag⁺), is particularly attractive as an antibacterial agent because it can be readily incorporated into dressing materials. When the materials contact an aqueous environment, the silver complex is dissociated (Ovington 2004, White & Cutting 2006). The mechanism of action for Ag⁺ is that it binds to bacterial cell DNA and enzymes and proteins in the cell wall. Once the silver cation attaches to these sites, it alters their structure, resulting in structural and functional changes in the bacterial cell (Ovington 2004). It is suggested by numerous authors that silver dressings should be used when critical colonisation within a wound occurs (Ovington 2004, White & Cutting 2006). However, the evidence base for this assertion is not particularly strong. If nurses are to provide evidence-based care to their patients a clear, evidence-based, body of knowledge should underpin their practice. In wound care, this means continually reviewing the evidence related to wound management (Leandro 2005, Melnyk & Fineout-Overholt 2005). This study conducts a meta-analysis of the current evidence base for the efficacy of silver dressings in the treatment of chronically infected wounds. Meta-analysis studies contribute to many aspects of clinical research, not only by enabling an increased statistical power of comparison but also in obtaining clear and reliable results that can be used as a basis for clinical guidelines (Leandro 2005). To date, two meta-analyses have included studies of silver-based dressings and topical agents on leg ulcers (Chambers et al. 2007, Vermeulen et al. 2007). However, information on economic evaluation, duration of dressing wear time and the frequency of dressing change was not specified enough for clinical application. Furthermore, this analysis also sought to analyse the evidence of patient preference and symptom control.

Aim of the study

This study’s purpose was to examine the efficacy and safety of silver-releasing dressings in the management of non-healing chronic wounds by conducting a meta-analysis of randomised control trials (RCT). Therefore, the research questions addressed in the current meta-analysis were:

• What are the mean effect sizes of silver-releasing dressing as a whole?
• What is the magnitude efficacy and safety of silver-releasing dressings?

Methodology

Search strategy for identification of studies

The search for eligible studies was comprehensive and involved multiple strategies. Relevant studies were identified by searching the electronic searches of the core bibliographic databases: PubMed, CINAHL via Ovid online, Cochrane Database, MEDLINE via Ovid online, EBSCO host, Proquest, British Nursing Index and OCLC. The search terms used to locate relevant studies are summarised in Table 1. Moreover, we also carried out hand searching of selected periodicals, reviewed reference lists of published papers, searched wound management websites and contacted wound dressing manufacturers. A search for unpublished literature was conducted through dissertation and conference abstracts. The time parameters of the search were from 1950s–June
The literature search was carried out on 30 June 2007 and papers were included in the review if retrieved by 5 July 2007 (Table 1).

Selection criteria
Screening of relevant studies for inclusion was conducted independently by S-FL and Y-TC Chang who used titles, publication years and abstracts. The criteria for considering studies for the review were as follows. Studies were assessed for inclusion based on inclusion criteria determined a priori (Fig. 1). Studies excluded after full paper review are presented in Table 2.

Type of studies
We performed a meta-analysis of primary studies, which concerned the effectiveness of interventions applied to management of non-healing chronic wounds. Owing to language and resource constraints, studies included were limited to published or unpublished papers in English or Chinese. RCT studies were included (single-group pre- and postcontrolled trials or experimental studies were excluded).

Type of participants
Study participants all had wounds that exhibited delayed healing or had wounds that were clinically diagnosed with critical colonisation or infection (acute wounds such as burns were excluded).

Type of intervention
To be included, studies should focus on silver dressing compared with non-silver dressings or silver dressing compared with traditional wound management, such as gauze.

Type of outcome measurement
Based on the protocol for this review the reported outcomes were classified as physical, psychological or economic.

Assessment of study quality
In this review, the title, abstract and key words of each identified record were screened for relevancy (step 1 screening) by the primary reviewers. Full-text articles were obtained for all remaining records. Non-English articles were obtained and translated as required. The same two reviewers independently assessed each full-text article. The quality and strength of the studies were evaluated using the CONSORT statement and the checklist developed by Melnyk and Fineout-Overholt (2005) was used to critically appraise RCT. A total of 15 study elements were critically appraised to determine a study quality score. The highest possible study quality score was 30; each item had a possible score of 0–2 (score of 0 = not done; 1 for unclear, 2 for done), with possible scores ranging from 0–30. Papers with a quality score over 60% (>18) of the total possible score were included in this analysis (step 2 screening; Table 3). Inter-rater agreement was calculated at each screening step with the use of Cohen’s kappa statistic.
Figure 1 Summary of study selection and exclusion.

<table>
<thead>
<tr>
<th>Study</th>
<th>Reason</th>
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</thead>
<tbody>
<tr>
<td>Chambers et al. (2007)</td>
<td>Systematic review and meta-analysis in leg ulcers</td>
</tr>
<tr>
<td>Bergin and Wraight (2006)</td>
<td>Systematic review in diabetic foot ulcer</td>
</tr>
<tr>
<td>Sibbald et al. (2005)</td>
<td>Lacking in rigour</td>
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<tr>
<td>O’Meara et al. (2001)</td>
<td>Lacking in rigour</td>
</tr>
<tr>
<td>Bolton (2006)</td>
<td>Lacking in rigour</td>
</tr>
<tr>
<td>Rayman et al. (2005)</td>
<td>Non-comparative study</td>
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<tr>
<td>Sibbalé et al. (2007)</td>
<td>Non-comparative study</td>
</tr>
<tr>
<td>Lazareth et al. (2007)</td>
<td>Non-comparative study</td>
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<tr>
<td>Schuman et al. (2007)</td>
<td>Non-comparative study</td>
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<tr>
<td>Karlmark et al. (2003)</td>
<td>Non-comparative study</td>
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<tr>
<td>Ziegler et al. (2006)</td>
<td>Non-comparative study</td>
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<tr>
<td>Vanscheidt et al. (2003)</td>
<td>Non-comparative study</td>
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<tr>
<td>Joergensen et al. (2007)</td>
<td>Non-comparative study</td>
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<tr>
<td>Verdu et al. (2007)</td>
<td>Non-comparative study</td>
</tr>
<tr>
<td>Rucigaj (2007)</td>
<td>Non-comparative study</td>
</tr>
<tr>
<td>Sigal-Grinberg et al. (2007)</td>
<td>No useable data was reported</td>
</tr>
<tr>
<td>Verdu Soriano et al. (2004)</td>
<td>Definition of outcomes unclear. No further data could be obtained</td>
</tr>
<tr>
<td>Rogers and Alvarez (2004)</td>
<td>Definition of outcomes unclear. No further data could be obtained</td>
</tr>
<tr>
<td>Serra et al. (2005)</td>
<td>Definition of outcomes unclear. No further data could be obtained</td>
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</table>
### Table 3 Summary of included studies

<table>
<thead>
<tr>
<th>Authors/ QS</th>
<th>Study design</th>
<th>Participant</th>
<th>Inclusion criteria</th>
<th>Intervention</th>
<th>Main outcome measured</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jude et al. (2007)</td>
<td>RCT; open label; stratified randomised</td>
<td>A total of 134 patients from 18 centres in four countries (Germany, Sweden, UK and France) I:67 vs. C:67 F:35 vs. M:99 average age 58.9 years Drop-out rate: 15.6% loss to FU</td>
<td>1. Type I or II diabetes mellitus with Wagner Grade 1 or 2 diabetic foot ulcers 2. Wound area ≥ 1 cm² 3. Use or non-use of systemic antibiotic 4. Risk of infection or infection</td>
<td>Eight weeks duration at admission, 4 weeks ± 2 days and 8 weeks ± 2 days wound evaluation I: Silver hydrofibre dressing C: Calcium alginate dressing Financially supported by a commercial company</td>
<td>Wound area: $W \times L \text{ (cm}^2\text{)}$ Wound depth: a sterile swab could be inserted into the wound Percentage of the wound bed tissues composition</td>
<td>1. Reduction of wound area: no significant differences between the two groups ($p = 0.975$) 2. Reduction of ulcer depth: I group had a significant decrease more than the C group ($p = 0.042$) 3. Wound bed tissues composition: no significant differences between the two groups ($p = 0.058$) 4. AE: no significant differences between the two groups</td>
</tr>
<tr>
<td>Verdu et al. (2004)</td>
<td>RCT; open label; simple randomised</td>
<td>A total of 125 patients from 10 centres in Spain I: 67 vs. C:58 Gender and age not reported Drop-out rate: 10.0% loss to FU</td>
<td>1. 18 years or above 2. Lesion with granulation and/or devitalised tissues 3. Chronic wound with no clinical signs of local infection</td>
<td>Six weeks duration at admission, unclear wound evaluation I: Silver charcoal dressing C: Hydropolymer adhesive dressing Financially supported by a commercial company</td>
<td>Lesion type and location Bacterial status (four categories)</td>
<td>1. Contaminated wounds: no significant differences between the two groups 2. Colonised wounds: no significant differences between the two groups 3. Wound with high level of bacteria: no significant differences between the two groups 4. Infected wound: I group had a significant decrease more than the C group ($p &lt; 0.001$) 5. AE: no significant differences between the two groups</td>
</tr>
<tr>
<td>Authors/ QS</td>
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<tr>
<td>Munter et al. (2006)</td>
<td>RCT; open label; block randomised</td>
<td>Setting: specialist wound care centre</td>
<td>A total of 619 patients from 80 centres in nine countries (Canada Germany, Belgium, Switzerland, UK, Denmark, Brazil, Slovenia and Italy)</td>
<td>1. 18 years or above 2. Wounds delayed healing 3. Moderate- to high levels of exudates 4. Ulcer depth &lt; 0.5 cm 5. Risk of infection or infection 6. Malodour 7. All types of wounds</td>
<td>Four weeks duration at admission and weekly evaluation of wound I: Silver hydrophilic foam dressing C: Local best practice (included gauze, hydrocolloid, foam/alginate and other active dressings)</td>
<td>Wound area: $W \times L$ (cm$^2$) $\times D$ (mm) Odour (four-point scale) Wound bed tissues composition (four tissue types) Exudate (four-point scale) Wound progress (six-point scale) EQ-5D (three-point scale) Pain (10-point numerical box scale) Time spent (four categories) Wear time (days)</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Authors/ Design</th>
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<th>Intervention</th>
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<th>Results</th>
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<tbody>
<tr>
<td>Jørgensen et al. (2006)</td>
<td>Patient in 15 countries in seven countries with critical colonisation</td>
<td>Silver hydrophilic foam dressing vs. Foam without silver dressing</td>
<td>1. Wound area: $W \times L$ (cm$^2$)</td>
<td>1. Reduction of wound area: I group had a significant decrease more than the C group ($p = 0.034$). 2. Odour: I group had a significant improvement more than the C group ($p = 0.003$). 3. EQ-SD: no significant differences between the two groups ($p = 0.008$). 4. Exudate: I group had a significant improvement more than the C group ($p = 0.003$). 5. Maceration: I group had a significant decrease more than the C group ($p = 0.008$). 6. AE: Four in I group and three in C group, no mention of statistical difference.</td>
</tr>
<tr>
<td>Romanelli and Price (2005)</td>
<td>Patients from multi-centre in UK and C.I.</td>
<td>Silver hydrophilic foam dressing vs. Foam dressing</td>
<td>1. Wound area: $W \times L$ (cm$^2$)</td>
<td>1. Reduction of wound area: I group had a significant decrease more than the C group ($p = 0.034$). 2. Odour: I group had a significant improvement more than the C group ($p = 0.003$). 3. Comfort during wear: no significant differences between the two groups ($p = 0.003$). 4. Pain: no significant differences between the groups ($p = 0.003$). 5. AE: Not reported.</td>
</tr>
<tr>
<td>S-F Lo et al. 2009</td>
<td>Patients from multi-centre in UK and C.I.</td>
<td>Silver hydrophilic foam dressing vs. Foam dressing</td>
<td>1. Wound area: $W \times L$ (cm$^2$)</td>
<td>1. Reduction of wound area: I group had a significant decrease more than the C group ($p = 0.034$). 2. Odour: I group had a significant improvement more than the C group ($p = 0.003$). 3. Comfort during wear: no significant differences between the two groups ($p = 0.003$). 4. Pain: no significant differences between the groups ($p = 0.003$). 5. AE: Not reported.</td>
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<tr>
<td>Sigal-Grinberg et al. (2007) (oral presentation; unpublished data) QS = 21/30</td>
<td>RCT; parallel and block randomised Setting: no clear report</td>
<td>A total of 102 patients from in multi-center in France I: 51 vs. C:51 F:63 vs. M:36 average age 74.9 years Drop-out rate: not unclear report</td>
<td>1. Perilesional erythema 2. Pain between two dressing changes 3. Malodours 4. Abundant exudates 5. Oedema</td>
<td>Eight weeks duration and weekly evaluation of wound I: Silver hydroalginate dressing C: Calcium alginate dressing Financial support not reported</td>
</tr>
<tr>
<td>Russell (2005) QS = 25/30</td>
<td>RCT; open label; parallel and block randomised Setting: chronic wound clinic</td>
<td>A total of 82 patients from 12 centres in UK I: 43 vs. C:39 F:36 vs. M:46 average age 73 years Drop-out rate: not unclear report</td>
<td>1. Medium- to high-level exudates (A Grade II–III pressure ulcer or diabetic foot ulcers) 2. 18 years of age or above 3. Full foul odour 4. Clinically infected ulcer 5. Wound with risk of infection</td>
<td>Four weeks duration and weekly evaluation of wound by wound care practitioners I: Silver hydrophilic foam dressing C: Local best practice (included gauze, hydrocolloid, foam/alginate and other active dressings) Financially supported by a commercial company</td>
</tr>
</tbody>
</table>
Information about methodological quality and potential risks of bias were used to guide sensitivity analyses and explore sources of heterogeneity.

Data extraction

A data extraction form was developed for the analysis and pilot tested prior to use. For all the trials baseline data, study design, statistical analysis and ethics, participant characteristic, outcome measure and adverse events were extracted. Double data collection was used to prevent errors during transcription of study results. In the meantime, data from each study were collated in tabular summaries to help identify outcomes that could be combined (meta-analysis) and characteristics of studies that should be considered when investigating variation in effect (heterogeneity).

Data analysis

A measure of the effect of an intervention is generated by comparing outcomes in the experimental compared with the control group: relative ratio/rate ratio (RR), odds ratios (OR), absolute risk reduction (ARR) or number needed to treat (NNT) from individual studies for binary data of effect measures. Mean difference, weighted mean difference (WMD), standardised mean difference (SMD) and 95% confidence intervals (95% CI) for continuous data of effect measures (NHS Centre for Reviews and Dissemination 2001).

The heterogeneity test plays an important role in the assessment of the consistency of effects across studies. A non-significant result suggests that no statistically significant heterogeneity is present. The Cochran’s Q-test and 95% CI was performed to evaluate heterogeneity within the identified studies. Significant heterogeneity was considered to be present when the p-value was < 0.05. In meta-regression, a way of exploring the reasons for the heterogeneity of results and adjustment for confounding effects is seen. In the absence of heterogeneity (p > 0.10) a fixed effect model was applied. On the contrary, in the presence of heterogeneity (p < 0.10), a random effects model was used; however, random effects model may be suitable if the number of studies is small (approximately less than 10; Abrams & Jones 2001, Sutton et al. 2001). Publication bias was examined with the use of funnel plots and with Egger tests (Petticrew & Roberts 2006). An analysis of sensitivity in the studies was performed by subgroup analyses according to similar dressings and similar patient groups. All statistical tests were two-sided. All analyses were conducted using Comprehensive Meta-Analysis, Version 2.
Results

Search results

Figure 1 shows the steps and criteria for search strategy and the number of trials evaluated at each stage of the systematic review. Primary searched studies resulted in potentially relevant citations and identified 1957 hits (step 1). The agreement between the two primary reviewers at this step of screening was substantial (estimated kappa = 0.79). Of these, 30 studies were reviewed and eight RCT were included. Twenty-two were excluded from the meta-analysis for the reasons outlined in Fig. 1. Agreement between the two reviewers at the second step of screening was almost perfect (estimated kappa = 0.93). Thereafter, two systematic and meta-analysis studies (Chambers et al. 2007, Vermeulen et al. 2007) on sliver dressing for chronic wound were reviewed and principle investigators contacted by e-mail to request additional information on meta-analysis. However, data were not available. Therefore, the final sample consisted of eight RCT studies published in English between 2004–2007. Of the eight studies, seven were published journal articles and one was unpublished conference article. All eight papers scored between 20–28 on the critical appraisal tool.

Assessment of methodological quality

Of the eight included studies, four were of high methodological quality. Two trials showed no evidence of sample size estimation (Romanelli & Price 2005, Munter et al. 2006) and an intention-to-treat analysis (Romanelli & Price 2005, Sigal-Grinberg et al. 2007). Four of the studies reported drop-out rates that varied from 10–19.2% and the remaining trials did not mention drop-out rates (Russell 2005, Jørgensen et al. 2006, Munter et al. 2006, Sigal-Grinberg et al. 2007). The sum of drop-outs from the group I was 25 and from the group C 24. There was no significant difference found in any of the studies (Table 3).

Study characteristics

Of the 1399 combined patients in the eight RCT, 721 were allocated for silver-relating dressings (group I) and 668 for without silver dressings (group C). Five studies were from single countries: UK (2), France (2), Spain (1) and multiple countries (UK, Germany, Canada, USA, Demark, Italy, Netherlands, Belgium, Switzerland, Brazil and Slovenia). Exactly, 597 participants in the studies were females and 466 were males. There were also 336 patients whose gender was not given. Average age ranged from 58–9–74–9 years. Two trials (Romanelli & Price 2005, Sigal-Grinberg et al. 2007) did not give details of patient ages. In addition, 48.73% (n = 579) of the studies reported including subjects with venous leg ulcer, 9.93% (n = 118) with mixed venous/arterial ulcer, 16.83% (n = 200) with pressure ulcer, 15.40% (n = 183) with diabetic foot ulcer and 9.09% with another type of non-healing chronic wound. Two trials (Russell 2005, Jørgensen et al. 2006) did not give details of wound type (Table 3).

All the trials compared silver-releasing dressing with a non-silver-releasing dressing (foam dressing, alginate dressing and hydro-polymer adhesive dressing). Silver dressings included hydrophilic polyurethane foam (Romanelli & Price 2005, Russell 2005, Jørgensen et al. 2006, Munter et al. 2006), hydroalginrate dressing (Meaume et al. 2005, Sigal-Grinberg et al. 2007), activated charcoal dressing (Verdu Soriano et al. 2004) and hydrofibre (Jude et al. 2007). The duration of intervention varied from four to eight weeks, all five studies included data after four weeks, one study six weeks and two studies included data after eight weeks of intervention. The majority of studies (n = 4) conducted a weekly evaluation of wound bed progresses. The studies used the following physiological outcome variables: wound area (n = 6), odour (n = 3), maceration (n = 3), exudates (n = 3), wound bed tissues composition (n = 2) and pain (n = 2).

Pooled efficacy and safety

Physiological outcomes

To examine the overall efficacy and safety of silver-relating dressings, six results were retrieved from eight studies (in some cases, more than one result was retrieved from a study). The results of our meta-analysis shows a significant effect of group I in wound area reduction compared with group C with the effect size 0.28 (CI95: 0.16–0.39, p < 0.001; t-test). Heterogeneity tests were obtained for six studies showing no significant difference between studies (p = 0.497; chi-square test).

Wound odour was described in three trials, which presented a significant effect of group I in wound odour improvement compared with group C with the effect size 0.38 (CI95: 0.24–0.52, p < 0.001; t-test). There was no significant between-study heterogeneity (p = 0.302; chi-square test).

For wound exudate, three trials showed a significant effect of group I in the wound exudate level reduction compared with group C with the effect size 0.31 (CI95: 0.17–0.44, p < 0.001; t-test). There was no statistical heterogeneity (p = 0.126; chi-square test).

A reduction in wound pain was described in two trials, which displayed a significant effect of group I more than group C with the effect size 0.33 (CI95: 0.18–0.47,
S-F Lo et al.

reduction in wound pain
wound exudates
wound odour
wound area reduction
dressing used and:

Sensitivity testing was conducted in relation to the type of dressing used and:
• wound area reduction
• wound odour
• wound exudates
• reduction in wound pain
• quality of life.

In all cases there was no statistically significant heterogeneity.

Psychological and economic outcomes
The results of our meta-analysis shows a significant effect of group I in the EQ-5D (Standardised instrument for use as a measure of health outcome) compared with group C with the effect size 0.18 (CI95: 0.04–0.33, p = 0.013; t-test). Heterogeneity test was obtained for two studies that showed no significant difference between studies (p = 0.349; chi-square test). For dressing wear time, two trials showed a significant effect of group I compared with group C with the effect size 0.33 (CI95: 0.19–0.48, p = 0.028; t-test). There was no significant between-study heterogeneity (p = 0.645; chi-square test).

Adverse events
Four of the studies included information about adverse events. No severe adverse events were registered in any of the studies. Three trials did not mention adverse events (Romanelli & Price 2005, Munter et al. 2006, Sigal-Grinberg et al. 2007). The deterioration of peri-ulcer skin and burning sensation were the main local adverse events reported (Table 3).

Sensitivity testing
Sensitivity testing was conducted in relation to the type of dressing used and:

Discussion
This systematic review adds to one previous review of silver-related dressings in chronic wounds by Vermeulen et al. (2007), which included three RCT assessing the effectiveness of silver in the treatment of contaminated and infected acute or chronic wounds. However, the authors highlighted that there was insufficient evidence to recommend the use of silver dressings for treatment of infected or contaminated chronic wounds. The results of this meta-analysis support the hypothesis that silver-dressings can improve wound bed composition in non-healing, chronically infected wounds. We found not only significant effectiveness of physical outcomes, reduction in wound area, reductions in malodour, decreases in wound exudates and wound pain, but also improvement in the participant’s quality of life and prolonged dressing wear time. The variety of outcome measures included in the studies within this meta-analysis strengthens the evidence base for their use – providing evidence of not only physical improve-
Clinical issues

Silver dressings meta-analysis

and Related Research and School of Nursing and Midwifery, This review was undertaken through the School of Health Acknowledgements

should be conducted when practitioners use this intervention. However, it may be the case that with industry-funded trials adverse events may be under-reported; therefore, an adverse events assessment should be conducted when practitioners use this intervention.

Relevance to clinical practice

Although providing a clear addition to the evidence base for practice this review also demonstrates the need for further investigation. First, several well-designed RCT are needed to clear up the continued uncertainty about the therapeutic effects of different type of silver-relating dressing on non-healing chronic wounds in various clinical settings and patient populations. Second, it is also important to describe the silver-relating dressing delivery mode, indications, contraindications, frequency and duration of treatment in future studies. Third, the application of the findings of this review is restricted to settings and patients similar to those in the primary studies. Most of the included studies did not mention trial setting and the majority were conducted in Europe, therefore, primary research is needed to examine the efficacy and safety of silver-relating dressings in healthcare circumstances in the East. Finally, although evidence of effectiveness is an appropriate standard from which to base reimbursement policies only two trials demonstrated a positive effect upon wear time, thus, further studies are need to evaluate the cost-effectiveness of silver-releasing dressings to inform health policy within wound care practice.

Conclusion

In conclusion, this meta-analysis of RCT confirmed that silver-releasing dressings can improve wound bed composition, enhance quality of life and save medical cost. However, we found that majority of the participants were older than 60 years of age and had several advanced chronic diseases. Understanding the differences in silver dressing efficacy among different populations is important when selecting patients for this treatment. Notwithstanding, this meta-analysis showed that silver dressings were associated with few adverse events and the authors of the papers reviewed reported no significance differences for these between groups I and C. However, it may be the case that with industry-funded trials adverse events may be under-reported; therefore, an adverse events assessment should be conducted when practitioners use this intervention.

Acknowledgements

This review was undertaken through the School of Health and Related Research and School of Nursing and Midwifery, University of Sheffield. Andrew Booth is thanked for his comments on the manuscript.

Contributions

Study conception and design: SL, LC; data collection and analysis: SL, WH, YC and drafting and critical revision of manuscript: SL, MH, WH, LC.

References


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