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RESEARCH

The efficacy of alarm therapy versus desmopressin therapy in the treatment of primary mono-symptomatic nocturnal enuresis: a systematic review

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Aim: To investigate the efficacy of alarm therapy versus desmopressin therapy in treating primary mono-symptomatic nocturnal enuresis (PMNE). **Background:** PMNE is a common childhood disorder, which if left untreated can have a significant impact on a child's self-esteem and behaviour. Alarm therapy and desmopressin therapy are the two main treatments currently available in UK-based nurse-led enuresis clinics. **Methods:** A systematic review of the literature was undertaken to assess the efficacy of PMNE treatments. Following application of inclusion/exclusion criteria eight randomised controlled/clinical trials were identified involving children aged 5–17 years with PMNE receiving either alarm therapy or desmopressin therapy. **Findings:** Seven studies found no statistical difference in nocturnal continence improvement between the two interventions at the point when treatment was stopped. Four studies had a significantly larger relapse rate of nocturnal enuresis with desmopressin compared with alarm therapy when the treatment was withdrawn. Two papers reported that those participating in the alarm therapy intervention of the trials had a higher attrition rate than the desmopressin intervention. The overall findings from the eight studies showed that long term alarm therapy was more effective in treating nocturnal enuresis than desmopressin therapy. The review found that families and children receiving the alarm therapy intervention require more support from health care professionals to comply with treatment than those receiving the desmopressin therapy. However, if nurse-led clinics can support families to persist with the alarm therapy intervention, they are more likely to experience longer term improvement in continence.

Key word: alarm therapy; children; desmopressin therapy; primary mono-symptomatic nocturnal enuresis.

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Background

This paper reports a systematic review, which aims to investigate the efficacy of alarm therapy versus desmopressin therapy in managing primary mono-symptomatic nocturnal enuresis (PMNE). Nocturnal enuresis is a common distressing condition in childhood, which if left untreated, can have increasing effects on a child's emotional well-being, social development and disruption for the family (Rogers, 2003; Weaver, 2010). Recent studies have shown that children with bedwetting are more likely to have behavioural problems

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(Joinson *et al.*, 2007) with the consequent stress within families being considerable with an increased risk of child punishment including child abuse (Sapi *et al.*, 2009).

Working with children who have nocturnal enuresis and their families is a vital role of health professionals across the world. They are central to assessing and implementing treatment plans. Nurses such as specialist community public health nurses within school health services in the United Kingdom play a major role. Increasingly, it is these specialist nurses who run nurse-led enuresis clinics in the United Kingdom following current guidelines (NICE, 2010). The first ever UK guidelines for the management of bedwetting published by National Institute for Health and Clinical Excellence (NICE, 2010) recommended alarm therapy as a first line treatment for this common condition with the second line treatment being desmopressin therapy. Evidence abounds supporting the use of these interventions when they have been trialled independently (Butler and Gasson, 2005; Del Gado *et al.*, 2005; Tüncel *et al.*, 2008; Tauris *et al.*, 2012).

Nevéus *et al.* (2006: 315) defined enuresis as: 'any type of wetting episode that occurs in discrete amounts during sleep' in a child of at least five years of age. NICE (2010) did not include an age limit but similarly defined nocturnal enuresis as: 'the symptom of involuntary wetting during sleep' (NICE, 2010: 4). Nocturnal enuresis has been categorised into two types, primary and secondary. Most children become dry by night between two and four years of age as a consequence 'primary' nocturnal enuresis describes the continuation of wetting beyond this normal age of development (Robinson *et al.*, 2003; Cox, 2009). Secondary nocturnal enuresis is defined as the recurrence of bedwetting after a period of six months of consistent nocturnal continence (Butler and Holland, 2000; NICE, 2010). Children with secondary enuresis need careful medical and psychological assessment before intervention as there could be an external reason associated with the reoccurrence of nocturnal urinary incontinence, such as illness, trauma or abuse (Brown *et al.*, 2010). A second classification system of nocturnal enuresis involves the presence or absence of bladder symptoms. Mono-symptomatic enuresis is enuresis in a child without any other lower urinary tract symptoms (Nevéus *et al.*, 2006), whereas non mono-symptomatic enuresis describes enuresis in a child with other lower urinary tract symptoms such as daytime incontinence (Nevéus *et al.*, 2006). Therefore, children diagnosed with PMNE are those who have never experienced six months of consistent nocturnal urinary continence and have no lower urinary tract symptoms.

Evidence from international epidemiological studies (Chang *et al.*, 2001; Rawashdeh *et al.*, 2002; Butler and Heron, 2008) indicates that the incidence of primary nocturnal enuresis is more prevalent in boys than girls, especially in younger ages, whereas secondary enuresis is more likely to occur in girls. Bedwetting less than two nights a week has a prevalence in the United Kingdom of 21% at 4.5 years of age and 8% at 9.5 years of age, with ~1–2% of children continuing to bed wet until their teens (Butler and Heron, 2008; ERIC, 2009). Despite the prevalence of nocturnal enuresis reducing as children grow older, not all children grow out of it, Butler (1994) stated that there are no valid predictors of which children will spontaneously become dry, a statement that still appears to be the case two decades later. It is vital therefore that support and intervention are available to reduce the detrimental impact that the condition can have on children and their families.

The causes of enuresis are not fully understood. Studies have shown some strong genetic predisposition for bedwetting with an increased risk if one or both parents have a history of the problem (Montaldo *et al.*, 2010), and a recent study by Lei *et al.* (2012) found microstructure abnormalities in the micturition control network of the brain, indicating that developmental delay in these areas may cause PMNE. Despite the causes not being fully understood, there are identified predisposing factors regarding enuresis, which include polyuria, bladder dysfunction and sleep arousal difficulties. This is known as 'The Three Systems Model', which was developed by Butler and Holland in 2000. In cases of primary enuresis, this model is a simple clinical tool that can be used to identify the child's predisposing factor to bedwetting and the most appropriate treatment (Butler and Holland, 2000; Yemula, 2006). Polyuria is caused by low levels of night time production of the human antidiuretic hormone, vasopressin leading to continual filling of the bladder to the equivalent of maximum daytime capacity. The bladder then exceeds this capacity, resulting in bedwetting.

Children will tend to wet the bed within a few hours of going to sleep and produce consistently large wet patches (Butler and Holland, 2000; Yemula, 2006). Bladder dysfunction, also known as bladder instability, occurs when the bladder does not remain stable while filling, leading to an abnormally low functional capacity. Children who have an instable bladder experience daytime urinary voiding symptoms such as urgency and frequency (Butler and Holland, 2000; Yemula, 2006). Sleep arousal difficulties in children can cause an inability to recognise signals that indicate a full bladder and are unable to wake to pass urine, leading to bedwetting. A child will only need to wake to void if either of the other two systems discussed are ineffective.

Management of enuresis

Historically there have been many strategies used by parents for nocturnal enuresis, such as sleep deprivation, fluid restriction and 'lifting' where parents lift the child from their bed and carry them or walk them to the toilet when the child is still asleep or not fully awake. However, interventions for nocturnal enuresis divide into two main areas, pharmacological and psycho logical (Butler, 1994; Butler and Gasson, 2005). The pharmacological treatment recommended is desmopressin therapy, with the psychological intervention being nocturnal alarm therapy (Butler and Holland, 2000; Yemula, 2006; NICE, 2010).

The enuresis alarm works by alerting a child to respond quickly when voiding commences during sleep. The alarm is a battery-operated device available in two formats, bed mat alarm or a body alarm. The alarms are triggered as soon as voiding starts by emitting a loud noise or vibration to wake the child who can then respond appropriately to the signal (Butler and Gasson, 2005; Yemula, 2006; Butler *et al.*, 2007). The key to success is not the intensity of the alarm, but the child's ability to wake and respond to the signal. The recommended treatment age is six to seven years when it is more likely that the child's developmental stage supports this ability (NICE, 2010). Desmopressin is a 'synthetic analogue' of vasopressin available as a tablet or a sublingual melt form from the age of five years (Yemula, 2006; NICE, 2010). Its effect lasts up to 8 h and is therefore taken at bedtime in order to reduce urine production and it is vital that no fluid is drunk an hour before taking the medication until waking in the morning to prevent potential risks such as water toxication, low sodium levels and seizures. Treatment can be continued over long periods with NICE (2010) recommending that the therapy should be halted for at least one week every three months to check if the child still requires treatment.

Management of enuresis is important as studies have shown that nocturnal enuresis can have a significant impact on a child's emotional state, social development and self-esteem (Butler, 1998; Theunis *et al.*, 2002). Children can feel different from their peers and live in fear of peers knowing about their condition. This can lead to social exclusion as they decline social activities, such as 'sleepovers' and school residential trips (Wootton and Norfolk, 2010). A survey by Van Tijen *et al.* (1998) of critical life events found that children with enuresis thought bedwetting was the third most severe event that they could encounter, behind divorce and parental fights. However, the literature is not consistent in this view, for example, a study by Robinson *et al.* (2003) found that children with nocturnal enuresis perceived themselves as similar to children without nocturnal enuresis.

Health professionals including school nurses are ideally placed to assist children with nocturnal enuresis to become continent as they see children between the ages of 5 and 16 years, which are the age ranges with the greatest prevalence (Cox, 2009). When assessing a child in a nurse-led clinic, any concerns expressed regarding their condition and their self- esteem should be considered before implementing an effective evidence-based treatment plan. It is also important to assess the family's needs and their ability to cope with both treatment options and the burden of bedwetting (Wootton and Norfolk, 2010). These elements of the assessment are particularly important because studies have shown treatment failures lower the child's self-esteem (Theunis *et al.*, 2002).

Methods

The systematic review research question was: What is the efficacy of alarm therapy versus desmopressin therapy in the treatment of PMNE?

Publications before 2011 were identified through searching five databases: Medline, EMBASE, Psych

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Table 1 Inclusion/exclusion criteria

Exclusion criteria	Inclusion criteria
Adults	Child and adolescent study population – 5–17 years
Secondary enuresis	Nocturnal enuresis
Day time wetting	Primary enuresis
Combination treatment therapy studies	Mono-symptomatic nocturnal enuresis
Non mono-symptomatic enuresis	Comparison of desmopressin versus alarm therapy
Sole comparison with other enuresis management	English language
Non-English language	RCTs/clinical trials

RCT = randomised controlled trial.

Info, CINAHL and British Nursing Index. The search strategy combined the thesaurus and free terms for the population, intervention and outcome facets. For the population, facet terms covering 'children' were paired with the intervention terms 'alarm', 'desmopressin' and 'vasopressin'. Finally, outcome facet terms to cover variations of 'nocturnal enuresis' were added. Selection bias was reduced through the careful selection of search terms and judicious use of interface truncations, wild card symbols and Boolean operators. Hand searching the reference list of all retrieved papers was used to identify further studies.

The inclusion/exclusion criteria shown in Table 1 were applied using database limits, which yielded 126 papers from the five databases. Titles and abstracts were then reviewed to identify eligible papers, removing duplicates and those that did not meet the inclusion criteria to yield 10 papers. Two further studies were excluded after reading the full papers (Figure 1).

Results

Methodological quality of papers

All included papers were critically appraised to establish their methodological quality using the Consolidated Standards of Reporting Trials (CONSORT) statement (Schulz *et al.*, 2010). This was an appropriate tool as all the studies were randomised controlled trials (RCTs) with the exception of Monda and Hussman's (1995) clinical trial. The quality assessment of studies was rated on the extent to which they met the CONSORT 25 item checklist regarding their design, data analysis and interpretation. The 25 items provide benchmarks of high-quality reporting of RCTs, thus enabling readers to fully evaluate the study. Three of the eight studies met most of the items and were rated strong, having a high level of quality (Ng *et al.*, 2005; Kwak *et al.*, 2010; Evans *et al.*, 2011). Three studies partially met the items and were rated moderate, having a medium level of quality (Monda and Hussman, 1995; Tuygun *et al.*, 2007; Vogt *et al.*, 2010). The final two studies (Wille, 1986; Ünüvar and Sönmez, 2005) met a limited number of the items and were rated weak, having a low level of quality (see Table 2). The inclusion of the latter two studies despite their weak quality rating was justified on the basis of the few trials in this area and, although their findings need to be interpreted with caution, they are clinically relevant.

Children were aged between 5 and 17 years across the eight studies, with sample sizes ranging from 40 to 251. The details of the included studies are presented in Table 2. All the studies examined the efficacy of desmopressin and alarm therapy in treating PMNE. Monda and Hussman (1995) undertook a clinical trial where participants chose the intervention that they received following a discussion of options, the other seven studies investigated the interventions using RCTs.

Six of the studies also excluded children who were currently or had previously received treatment for enuresis (Wille, 1986; Ng *et al.*, 2005; Ünüvar and Sönmez, 2005; Kwak *et al.*, 2010; Vogt *et al.*, 2010; Evans *et al.*, 2011). All papers provided a definition of PMNE, although this varied between studies. All studies asking participants to complete voiding diaries pre-study to ensure that the sample met the criteria before final inclusion and allocation to an intervention. The seven RCTs differed in their method of randomisation. Four studies used block randomisation of

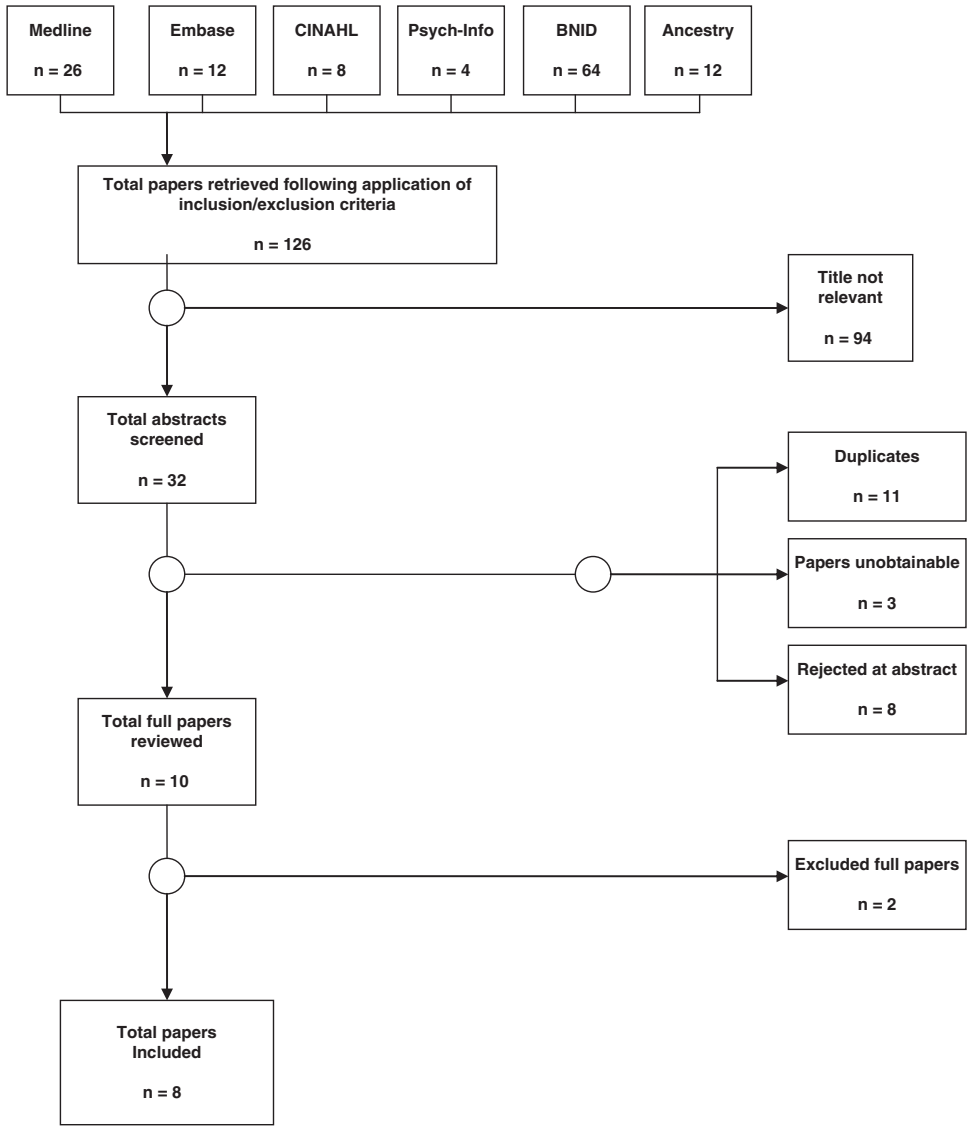

Figure 1 Search findings

participants to the intervention groups (Ng *et al.*, 2005; Kwak *et al.*, 2010; Vogt *et al.*, 2010; Evans *et al.*, 2011). Vogt *et al.* (2010) undertook manual randomisation using shuffle cards and three studies did not state the method of randomisation (Wille, 1986; Ünüvar and Sönmez, 2005; Tuygun *et al.*, 2007). The duration of the trials and subsequent follow up varied across the studies with duration ranging from two to six months and follow-up ranging from 1 to 12 months. However, only Vogt's *et al.* (2010) trial reported no follow-up. Data collection was in the form of voiding diaries completed by the participants for all studies. Compliance indicators were clearly stated as were the success criteria, again these varied between studies.

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Table 2 Table of results

Authors, year and country	Study design sample and study quality[a]	Length of initial study and follow-up	Intervention (I)	Counter intervention (CI)	Results on completion of intervention	Results on completion of follow-up
Wille (1986) Sweden	RCT Age: >6 years with >3 wet nights/week ($n = 50$). Study quality: weak	Initial study: three months. Follow-up: four weeks relapses reported on for a further two months. Relapses given a further three months of treatment. Success = 0–5 wet nights/month	Bed alarm ($n = 25$). Sudden withdrawal of treatment after three months	Desmopressin 20 μg intranasal nightly ($n = 25$). Sudden withdrawal of treatment after three months	Statistically significant difference between alarm and desmopressin result at three months ($P < 0.02$). 86% improvement with the 'I' and 70% with 'CI'	Significance increased at follow-up due to relapse rate of CI ($P < 0.001$). One child relapsed with no improvement after three months in the 'I' group. In the 'CI' group 10 children relapsed. Eight had not improved after three months
Monda and Husmann (1995) United States	Clinical trial Age: 5–17 years. Median age of 10 years with >3 wet nights/week ($n = 167$). Study quality: moderate	Initial study: six months. Follow-up: six months. Success = 0–1 wet nights/month	Body alarm ($n = 41$) bed alarm/($n = 38$). Total ($n = 79$). Sudden withdrawal of treatment after six months	Desmopressin 20 μg intranasal 30–40 minutes before retiring ($n = 88$). If wet after three nights dosage increase by 10 μg to maximum of 40 μg then dosage maintained. Treatment weaned by 10 μg a week and then 10 μg alternate nights for two weeks	No statistically significant difference between alarm and desmopressin result at three months ($P = 0.01$). 66% ($n = 52$) continent at three months in 'I' group; 68% ($n = 60$) continent in 'CI' group	At 12-month follow-up in 'I' group 56% ($n = 44$) were continent. Statistically significant at $P < 0.001$, compared with 10% ($n = 9$) in 'CI'
Ng *et al.* (2005) Mainland China	RCT Age: 7–15 years with >3 wet nights/week ($n = 73$). Study quality: strong	Initial study: 12 weeks. Follow-up: 12 weeks. Success = 0–1 wet nights/month	Bed alarm ($n = 35$). Sudden withdrawal of treatment after 12 weeks	Desmopressin orally 20 μg initially and increased to 40 μg after two weeks or anytime thereafter if had >1 wet night a week ($n = 38$). Sudden withdrawal of treatment after 12 weeks	No statistically significant difference between alarm and desmopressin. Frequency of wetting – 46% reduction in wetting in 'I' group versus a 52% reduction in 'CI' group	No statistical significance at 12-week follow-up in 'I' group there was a 52% reduction in wetting compared with 37% reduction in wetting in 'CI' group
Ünüvar and Sönmez (2005) Turkey	RCT Age: 5–15 years with >3 wet nights/week ($n = 40$). Study quality: weak	Initial study: two months. Follow-up: four weeks. Success = >85% reduction a month	Bed alarm ($n = 20$). Sudden withdrawal of treatment after two months	Desmopressin intranasal 20 μg a night for two months ($n = 20$). Sudden withdrawal of treatment after two months	No statistically significant difference between alarm and desmopressin $P = < 0.0124$	At four-week follow-up the 'I' group had a relapse rate of 14% compared with the 'CI' group's relapse rate of 6.25%. Statistical significance was not reported
Tuygun *et al.* (2007) Turkey	RCT Age: 6–13 years with >3 wet nights per week ($n = 84$). Study quality: moderate	Initial study: three months. Follow-up: three months. Success = > 90% dry nights/month	Bed alarm ($n = 35$). Sudden withdrawal of treatment after three months	Desmopressin nasal Spray – 20–40 μg at night ($n = 49$). Sudden withdrawal of treatment after three months	No statistically significant difference between alarm and desmopressin $P = 0.0885$. 82.85% success rate in 'I' group compared with 81.63% success rate in 'CI' group	At three-month follow-up in 'I' group there was a 54.28% success rate compared with a 26.53% success rate in the 'CI'. Statistically significant $P = 0.007$

Table 2 ***Continued***

Authors, year and country	Study design sample and study quality[a]	Length of initial study and follow-up	Intervention (I)	Counter intervention (CI)	Results on completion of intervention	Results on completion of follow-up
Kwak *et al.* (2010) Korea	RCT, cross-over Age: 6–15 years with >3 wet nights/week ($n = 104$). Study quality: strong	Initial study: 12 weeks. Follow-up: 12 weeks. Success =>50% reduction of wetting/month	Body worn alarm ($n = 50$). Sudden withdrawal of treatment after 12 weeks	Desmopressin orally 20 μg increased to 40 μg if no response after two weeks ($n = 54$). Reduced dose withdrawal over three weeks	No statistically significant difference between alarm and desmopressin $P = 0.433$. 82% success rate in 'I' group with 50% having a full response at 12 weeks, compared with 77.8% success rate in 'CI' group with 37% having a full response at 12 weeks	At 12-week follow-up the 'I' group had a relapse rate of 12% compared with the 'CI' group's relapse rate of 50%. Statistically significant $P = 0.005$. Cross-over study: order of intervention not statistically significant $P = 0.961$
Vogt *et al.* (2010) Germany	RCT Age: 5–15 years with >3 wet nights/week ($n = 43$). Study quality: moderate	Initial study: three months. Follow-up: none. Success = 0–1 wet nights/month	Bed alarm ($n = 19$). Sudden withdrawal of treatment after three months	Desmopressin 20 μg nightly for two weeks and 40 μg for further 10 weeks ($n = 24$). Sudden withdrawal of treatment after three months	No statistically significant difference between alarm and desmopressin. 26% (9/19) success rate in 'I' group compared with 16.7% (4/24) success rate in 'CI' group	No follow-up, patients not continent after three months entered a further trial
Evans *et al.* (2011) England	RCT Age: 5–16 years with >6 wet nights/fortnight ($n = 251$). Study quality: strong	Initial study: six months. Follow-up: one month and 12 months by telephone. Success =>90% dry nights/month. Using a block size of four patients were randomised 3:1 to the desmopressin or alarm due to the estimated response rate of 60% and 98% power to detect a significant difference	Bed alarm ($n = 59$). Treated for ≤6 months until 14 consecutive nights dry or investigator believed treatment of no further use	Desmopressin Two-week 'run-in' period of 20 μg ($n = 192$). ≤1 wet night during run-in received 20 μg >1 received 40 μg daily. Treated for ≤6 months until 14 consecutive nights dry or investigator believed treatment of no further use	No statistically significant difference between alarm and desmopressin $P = 0.3244$. In the 'I' group 37% (22/59) of patients achieved dryness at six months compared with the 'CI' group where 32% ($n = 61/192$) of patients had achieved dryness at six months	Although the mean number of wet nights had decreased in both groups: ● the high drop-out rate ● the continuation of different treatments for those continuing to experience PMNE ● difficulty in collecting data at 1- and 12-month follow-ups invalidated analysis

RCT = randomised controlled trial; PMNE = primary mono-symptomatic nocturnal enuresis.
[a] Assessed against CONSORT checklist.

Findings from alarm therapy and desmopressin therapy interventions

Seven of the eight studies had similar findings between the two interventions at the point when the intervention was stopped with no statistically significant difference in nocturnal continence improvement. Wille (1986), however, reported a significant improvement in the alarm therapy group compared with desmopressin at this stage ($P < 0.02$). Four of the seven studies that included a follow-up showed a statistically significant difference ($P \leq 0.001$ to $P = 0.007$) between the intervention groups at the end of the follow-up (Wille, 1986; Monda and Hussman, 1995; Tuygun *et al.*, 2007; Kwak *et al.*, 2010). Desmopressin groups in these four studies had larger relapse rates of nocturnal enuresis compared with the alarm intervention and as a consequence by the end of the trials there was a significant difference between the two intervention groups, with participants who had used alarm therapy having higher rates of continence than those who had taken desmopressin. The sudden withdrawal of treatment (Wille, 1986; Ng *et al.*, 2005; Ünüvar and Sönmez, 2005; Tuygun *et al.*, 2007), or reduced dose withdrawal of desmopressin (Monda and Hussman, 1995; Kwak *et al.*, 2010) did not produce a difference to the relapse rate.

Two studies highlighted that those participating in the alarm therapy arm of the trials had a higher attrition rate than the desmopressin arm. Evans *et al.* (2011) noted 58% ($n = 34$) did not complete the alarm therapy arm compared with 44% ($n = 85$) who did not complete the desmopressin arm, whereas Ng *et al.* (2005) recorded a 20% ($n = 7$) attrition rate with alarms versus 5% ($n = 2$) attrition rate with desmopressin. Three papers reported similar attrition/non-compliance rates between the intervention groups (Wille, 1986; Monda and Hussman, 1995; Kwak *et al.*, 2010) while the other three studies either did not report an attrition rate or did not attribute the attrition to a specific group. Reasons stated for attrition/non-compliance with the alarm therapy intervention were anxiety of the alarm noise during the night, alarms not being triggered when voiding occurred, alarms sounding when no voiding occurred and most frequently was the alarm not waking the child but disturbing the rest of the household. Reasons for the attrition/non-compliance from the desmopressin groups were fear of drug dependency, nasal discomfort from the intranasal spray and concerns with unrelated health issues. None of the studies reported an association between the age of the child and attrition/non-compliance, although this could have been anticipated for children at the lower end of the age range.

Limitations of the review

There are a number of limitations of this review relating to methodological issues, thus the findings need to be considered with caution:

(i) the rigour of some of the studies was weak with regard to their small population sizes (Ünüvar and Sönmez, 2005; Vogt *et al.*, 2010), short intervention period (Ünüvar and Sönmez, 2005) and variable follow-ups during the trials (Wille, 1986; Vogt *et al.*, 2010).

(ii) There was significant heterogeneity across the studies making comparison difficult and preventing a meta-analysis. For example, the trials' success criteria varied considerably with Monda and Hussman (1995) and Vogt *et al.* (2010) defining success as 0–2 wet nights/month, whereas Kwak's *et al.* (2010) success criterion was >50% reduction of wetting/month. Other trials distinguished success by defining complete and partial response (Wille, 1986; Ng *et al.*, 2005; Ünüvar and Sönmez, 2005; Tuygun *et al.*, 2007; Evans *et al.*, 2011). This latter point, however, is similar to the real-life clinic situation where parents and children have varying success criteria such as a reduction of wet nights rather than complete continence (Butler and Gasson, 2005).

(iii) Different types of desmopressin were used in the trials. Four of the eight studies used nasal rather than oral/sub-lingual desmopressin (Wille, 1986; Monda and Hussman, 1995; Ünüvar and Sönmez, 2005; Tuygun *et al.*, 2007). Whereas NICE (2010) guidelines on desmopressin in the United Kingdom state that either an oral or sub-lingual preparation with dosage ranging from 20 to 40 μg nightly should be used. This change in practice could overcome some of the reasons given for non-compliance such as nasal discomfort. Regarding clinical validity it should also be noted that interventions based on randomised trials may not reflect a real enuresis

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clinic situation, where both parents and child discuss their treatment choices rather than being randomly allocated a treatment. However, the clinical trial by Monda and Hussman (1995) reported no significant difference in attrition rates compared with the randomised studies.

Discussion

The overall findings from the eight studies showed that long-term alarm therapy was more effective in treating nocturnal enuresis than desmopressin therapy. Tuygun *et al.* (2007) found that alarm therapy was 5.5 times more effective showing that it is an appropriate first-line treatment. The findings of these studies echo previous studies comparing enuresis alarm therapy with no-treatment controls, showing 65–75% effectiveness, with a relapse rate in six months following treatment of 15–30% (Butler and Robinson, 2002; Butler and Gasson, 2005). The success rate with desmopressin and no-treatment controls (Hunsballe *et al.*, 1998; Del Gado *et al.*, 2005; Tuncel *et al.*, 2008) also showed a similar success rate of between 10% and 86% with a high relapse rate upon discontinuation of the drug.

Despite the success rates of alarm therapy in achieving a higher sustained improvement that persists, there is some indication that this intervention has a higher attrition rate compared with the desmopressin intervention (Ng *et al.*, 2005; Evans *et al.*, 2011). Enuresis alarm treatment is a 'demanding and time-consuming intervention' and can take between five and 12 weeks for success to be recognised (Butler and Robinson, 2002; Butler and Gasson, 2005). In the eight included studies, there was no significant extra support given to the intervention arms apart from the scheduled study follow-up clinics at around three months. It also appears that no further information was given to the study sample or families other than waking the child to void if not roused by the alarm (Kwak *et al.*, 2010; Vogt *et al.*, 2010).

These findings emphasise the importance in assessing a child's and family's willingness and tolerance to commence treatment that requires active long-term intervention before success in bedwetting is achieved. Experiences of some study participants included alarms not waking the child but disturbing the household, not being triggered on voiding and labour intensity (Wille, 1986; Monda and Hussman, 1995; Ng *et al.*, 2005; Vogt *et al.*, 2010; Evans *et al.*, 2011). These experiences have been reported in other alarm therapy studies (Butler and Gasson, 2005; Tuncel *et al.*, 2008). The included studies reported higher attrition among families using alarm therapy suggesting the need for additional support required during the initial stages of alarm use to enable a successful outcome. This concurs with the NICE guidelines (2010), which recommended a follow up appointment of 'up to four weeks' after alarm treatment is initiated, although they do not specify the type of follow-up required. Further Butler and Gasson (2005) and Joinson *et al.* (2007) have suggested that children with enuresis have lower self-esteem so that this support seems vital to aid treatment adherence and self-motivation. This is especially significant to prevent the effect of treatment failure lowering the child's self-esteem (Theunis *et al.*, 2002).

Longstaffe *et al.* (2000) found that regular support had a positive result on compliance with enuresis treatments, children's self-esteem and parental tolerance. Two subsequent studies (Butler and Robinson, 2002; Butler and Gasson, 2005) have also reported the significant impact of support upon enuresis treatment compliance. Nurse-led enuresis clinics therefore need to consider cost-effective support strategies needed to provide an efficient and effective service.

Desmopressin also has an important role in the treatment of enuresis, however, the high relapse rate can mean that long-term treatment plans should be anticipated (Alloussi *et al.*, 2011). The quick acting success of desmopressin in reducing wet nights has led NICE (2010) to recommend it as first-line treatment for parents and children when alarm therapy is not deemed appropriate, for example, when the child is unable to comply due to their age or level of competence, or where there is parental intolerance and an increase in the risk of abuse (Del Gado *et al.*, 2005; Alloussi *et al.*, 2011).

Implications for practice

Health professionals need to recognise that nocturnal enuresis is a common, and a distressing problem among children and young people. It can be a humiliating and socially isolating experience

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for children and lead to high levels of conflict and stress within families (Robinson *et al.*, 2003; Cox, 2009). Professionals should therefore encourage active management of this condition from the age of six to seven years. Alarm therapy has been shown to be a successful first-line intervention for managing PMNE compared with desmopressin therapy. However, the persistence required and inconvenience associated with alarm therapy can result in a high attrition rate, so that additional skilful support is needed to help families comply with and benefit from the intervention. Professionals should heed families' preference and motivation when selecting treatment to maximise compliance and achieve the optimum outcome for each child (Butler and Gasson, 2005; Evans *et al.*, 2011).

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