Nonpharmacologic Management of Neonatal Abstinence Syndrome: An Integrative Review

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The purpose of this article is to demonstrate that nonpharmacologic management is an effective tool for neonatal abstinence syndrome symptom treatment.

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Abstract

Neonatal abstinence syndrome (NAS) affects 3.39 in every 1,000 live births. A literature review was conducted to determine the varying types of nonpharmacologic management being used currently and its effect on the treatment of NAS symptoms. Fourteen articles were found that used nonpharmacologic management in the treatment of NAS. Therapies included breastfeeding, positioning, rooming-in, acupuncture/acupressure, and beds. Each of the nonpharmacologic therapies in these articles, with the exception of rocking beds, was shown to have a positive effect on the newborn with NAS. These effects include a shorter length of stay, a decrease in NAS scores, a decrease need for pharmacologic treatment, less agitation, a better quality of sleep, and a decrease in the severity of NAS symptoms. This review article shows that nonpharmacologic management is an effective tool for NAS symptom treatment.

Keywords: neonatal withdrawal; alternative therapies; nonpharmacologic treatment; treatment for neonatal abstinence syndrome

Neonatal abstinence syndrome (NAS) is defined as a condition or state in which neonates experience withdrawal symptoms after in utero exposure to opioids or other substances from maternal use. Manifestation of symptoms depends on the length of substance ingestion by the mother and the individual newborn's response to the abrupt cessation of the substance. Symptoms are related to the hyperirritability of the central nervous system (tremors, increase muscle tone, high-pitched cry, exaggerated primitive reflexes, altered sleep–wake cycles, seizures), the gastrointestinal tract (vomiting; loose stools; poor feeding; uncoordinated, constant sucking; failure to thrive), and autonomic dysfunction (sweating, sneezing, temperature instability, nasal stuffiness, yawning).[1–4] The newborn with withdrawal symptoms may require lengthy stays in the NICU.

The incidence of NAS has dramatically increased in the last decade. In 2009, it was estimated that one newborn per hour was born with NAS in the United States[3] and that the estimated mean cost of treatment for a newborn with NAS was >$50,000.[2]

Patrick and colleagues[5] identified infants from a serial cross-sectional analysis, using Healthcare Cost and Utilization Project's Kid's Inpatient Database, compiled by the Agency for Healthcare Research and Quality. From this compilation, they found that mean hospital charges for newborns diagnosed with NAS between 2000 and 2009 rose by 35 percent. Between 2000 and 2009, the incidence of NAS among newborns increased from 1.2 to 3.39 per 1,000 live births ($p < .001$). The average length of stay for a newborn with NAS was 16 days. Medicaid was the primary payer for most hospital charges increasing from 68.7 percent in 2000 to 77.6 percent in 2009. Between 2000 and 2009, overall charges for NAS had increased from $190 million to $720 million.

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Tolia and colleagues[6] conducted a multiple cross-sectional analyses using the Pediatrix Clinical Data Warehouse. They gathered data from 299 NICUs with infants discharged with a diagnosis of NAS. They discovered in 2004 that 7 out of 1,000 cases admitted to a NICU were for NAS. By 2013, that number had increased to 27 cases out of 1,000. The median length of stay rose from 13 days to 19 days. The researchers also discovered that the use of pharmacotherapy in the treatment of these infants with NAS increased from 74 to 87 percent as well as an increase in the duration of pharmacotherapeutic treatment.

A measure to potentially decrease the cost of NAS is to shorten the length of stay for newborns with NAS. Pharmacologic management appears to be the most researched method of treatment for NAS. Nonpharmacologic treatment is recommended in conjunction with pharmacologic management.[7] This combination can potentially shorten hospital stays[8,9] and decrease the amount of pharmacotherapy these newborns require. Both of these interventions would decrease the overall cost of NAS and benefit the newborn and mother. Nonpharmacologic therapies, however, do not have the potential side effects of pharmacotherapy. The purpose of this review was to determine the varying types of nonpharmacologic management being used for the treatment of NAS.

METHODS

This review was conducted using the five stages of an integrative review as outlined by Whitmore and Knafl.[10] These stages are as follows: (1) problem identification and formulation, (2) literature search, (3) data evaluation, (4) data analysis, and (5) presentation. This integrative review was performed to determine the varying types of nonpharmacologic management being used for the treatment of NAS.

The electronic databases searched were PubMed, Cumulative Index of Nursing and Allied Health Literature, MEDLINE, and PsycINFO. Articles were included if they were published in English from January 1988 to present, published as an original article in a peer reviewed journal, and described a nonpharmacologic treatment for NAS. The initial search key phrase was *treatment for neonatal abstinence syndrome*, which retrieved 716 citations. A second search was performed with the terms *neonatal abstinence syndrome*, *alternative therapies*, *complementary and alternative medicine*, and *neonatal withdrawal*. We retrieved a total of 112 articles. Each study was evaluated for content related to neonatal/infant abstinence syndrome using nonpharmacologic treatments regardless of the primary or secondary aim of the study. This method was used to ensure inclusion of all studies that described NAS and/or identified nursing care strategies to improve outcomes for NAS infants. A supplemental search strategy included reviewing the reference lists of articles selected as relevant. A diagram of the decision-making process for inclusion in the integrative review is provided in Figure 1. Ninety-eight articles were excluded because they were either duplications or they did not contain information on a nonpharmacologic treatment for neonates/infants with NAS. Fourteen articles were included in this review and examined for their hierarchy of evidence.

The hierarchy of evidence for each article was assessed using the rating system described in Melnyk and Fineout-Overholt.[11] For each study, the level of evidence (LOE) was assessed using a 7-level scale (Melnyk & Fineout-Overholt[11]), ranging from Level 1 (the strongest evidence systematic review or meta-analysis of all relevant randomized controlled trials [RCTs], or evidence-based clinical practice guidelines based on systematic reviews of RCTs) to Level 7 (the weakest evidence: opinion of authorities and/or reports of expert committees). Only four studies were graded Level 2 (RCT). Ten of the articles were graded Level 4 (moderate evidence from a well-designed cohort study). All 14 studies were included in this review because of the limited research in this area.

Each article was independently appraised by the authors. A predesigned form for extracting information from each study was used. It included information about the author, year, the place of the study, the study design, LOE, the nonpharmacologic treatment used, sample size, and the main findings. The 14 articles included in this review are summarized in Table 1. Four were retrospective cohort studies, two were clinical trials, one was a repeated measures experimental design, one was a retrospective comparative review, one was a clinical observation, and five were retrospective chart reviews.

RESULTS

Five major themes emerged from the analysis of retrieved documents as nonpharmacologic treatments for infants/neonates with NAS. These themes were (1) breastfeeding, (2) positioning, (3) rooming-in, (4) acupuncture/acupressure, and (5) specialized beds. Six articles discussed the advantages of breastfeeding as a nonpharmacologic therapy in the NAS population.[9,12–16] Researchers found that breastfeeding could be correlated with a shorter length of stay, a decrease in NAS scores, a decrease need for pharmacologic treatment, and a decrease in the severity of NAS symptoms. One article proved that prone positioning could lower NAS scores and decrease agitation in the newborn with NAS.[17] A third nonpharmacologic treatment for NAS found in three studies was rooming-in which has been associated with a decrease in the severity of NAS symptoms and a shorter length of stay.[8,18,19] Acupuncture/acupressure was found in the literature as a viable, nonpharmacologic treatment for NAS. Two studies concluded that acupuncture/acupressure can decrease medication requirements and result in a better quality of sleep for the newborn with NAS.[20,21] The final nonpharmacologic therapy found in the literature involved specialized bed selection. Nonoscillating waterbeds were shown to decrease the severity of NAS and need for medications.[22,23]

FIGURE 1 ■ Diagram of the systematic search strategy.

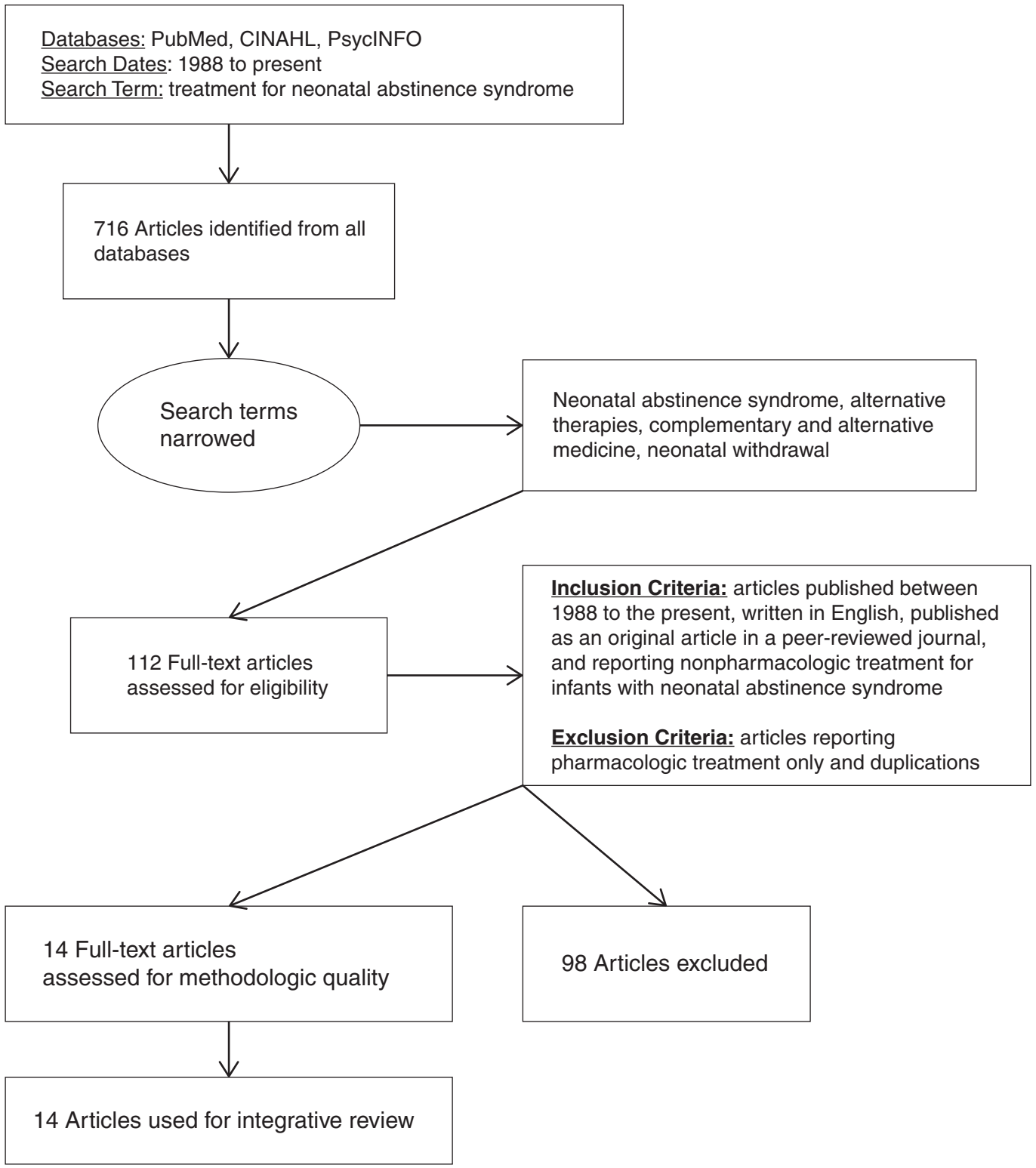

TABLE 1 ■ List of Articles Reviewed

Author/Year	Country	Study Design LOE	Intervention(s)	Sample Size	Outcome(s)
Abdel-Latif and colleagues (2006)	Australia	Retrospective cohort study Study Level: 4	Breastfeeding	190	Median time to withdrawal occurred later in breastfed infants (10 d vs. 3 d, $p < .001$) Breastfed infants were less likely to require pharmacologic treatment for withdrawal (52.9% vs. 79.0%, $p < .001$) .
Abrahams and colleagues (2007)	Canada	Retrospective cohort study Study Level: 4	Rooming-in	106	Rooming-in associated with decrease in NAS treatment (5.9 d vs. 18.6 d, $p = .003$) Also associated with fewer days in hospital (11.8 d vs. 23.5 d, $p < .001$)
Abrahams and colleagues (2010)	Canada	Retrospective comparative review Study Level: 4	Rooming-in	952	Rooming-in associated with decreased need for NICU stay (38.9% vs. 45.0%, $p = .01$) Length of stay in NICU significantly shorter for rooming-in infants (1.1 d vs. 3.1 d, $p < .001$)
Ballard (2002)	United States	Clinical observations Study Level: 4	Supportive care; breastfeeding	10	Breastfed infants had shorter stays and decrease need for withdrawal treatment.
D'Apolito (1999)	United States	Repeated measures experimental design Study Level: 2	Rocking bed	14	Significant against use of rocking bed; concluded that NAS infants are possibly too sensitive to mechanical rocking for this intervention to be effective
Filippelli and colleagues (2012)	United States	Retrospective chart review Study Level: 4	Non-insertive acupuncture	54	Infants slept better and deeper; relaxed agitated infants; better feeding
Hodgson and Abrahams (2012)	Canada	Review of medical records Study Level: 4	Rooming-in	295	Rooming-in infants had less significant withdrawal symptoms than infants who did not room-in.
Isemann and colleagues (2011)	United States	Retrospective review Study Level: 4	Breastfeeding	128	Breastfeeding associated with shorter length of stay and shorter duration of pharmacologic treatment.
Maichuk and colleagues (1999)	United States	Clinical trial Study Level: 2	Positioning	48	Prone positioning led to decrease in severity of NAS.
McQueen and colleagues (2011)	United Kingdom	Retrospective chart review Study Level: 4	Breastfeeding	28	Breastfed infants had decreased severity and duration of NAS.
O'Connor and colleagues (2013)	United States	Retrospective chart review Study Level: 4	Breastfeeding	85	Infants who were breastfed had less severe symptoms and less likely to require pharmacologic treatment than formula-fed infants.
Oro and Dixon (1988)	United States	Clinical trial Study Level: 2	Waterbed care	30	Infants placed on waterbeds had less severe symptoms, had better weight gain, and slept better.
Schwartz and colleagues (2011)	United States	Four-year, randomized, prospective study Study Level: 2	Auricular acupuncture	76	A potential treatment for NAS—not significant in this study
Welle-Strand and colleagues (2013)	Norway	Retrospective cohort study Study Level: 4	Breastfeeding	124	Breastfed infants had lower incidence of NAS and shorter length of pharmacologic treatment.

Abbreviations: LOE = level of evidence; NAS = neonatal abstinence syndrome.

Breastfeeding

Breastfeeding has been shown to have numerous advantages for both mother and infant. It has been shown to be a protective agent against sudden infant death syndrome (SIDS), a syndrome whose incidence is increased in NAS.[24] It also promotes infant attachment and bonding.[25] Breastfeeding is compatible with methadone and buprenorphine therapy as indicated by the American Academy of Pediatrics, the American College of Obstetrics and Gynecologists, and the American Academy of Addiction Medicine.[13] Both of these drugs are excreted in small amounts in breast milk.[3] Researchers found infants who breastfed and whose mothers were treated with either methadone or buprenorphine had a statistically significant shorter length of stay,[9] a shorter time in treatment,[9] a decrease in NAS scores,[14,15] a decrease need for pharmacologic treatment,[15,16] and a decrease in the severity of NAS symptoms[14] when compared with infants who were formula-fed.

A retrospective chart review by O'Connor and colleagues[13] was conducted on 85 infants born to opioid-dependent mothers treated with buprenorphine from December 2007 to August 2012. Researchers studied the relationship between breastfeeding and the frequency of pharmacologic treatment of NAS as well as the severity and duration of NAS. Although not statistically significant, the results showed the following: The mean peak NAS score was lower in the breastfeeding group than the nonbreastfed group (8.83 vs. 9.65); 23.1 percent of breastfed infants required pharmacologic treatment compared with 30 percent of nonbreastfed infants; the severity of NAS symptoms (scores 12 or higher) were lower (17 percent) in the breastfed group than in the nonbreastfed group (30 percent); and symptoms of NAS started to resolve two hours earlier in the breastfed group (76.1 vs. 78.3 hours).

Limitations to this study include the lack of reliability in the charting, possibility for bias in charting NAS scores, the large number of breastfed infants compared with nonbreastfed infants contributing to a larger standard error, and the other nonpharmacologic treatment modalities (i.e., skin-to-skin contact in the breastfed group) that may have contributed to the results. A modified Finnegan scoring system was used, but reliability and validity of the tool were not provided. According to the study, pediatric and obstetric nurses performed all scoring, but training information was not disclosed. Although the study was not statistically significant, it does contribute to previous data that supports the same conclusion that breastfeeding has a positive effect on infants with NAS. Further research studies with a larger sample size and measures with documented reliability would be beneficial.

Welle-Strand and colleagues[16] studied 124 women treated with methadone or buprenorphine and their neonates. The researchers found that the infants who were breastfed by the mothers on methadone maintenance had a lower incidence of NAS (53 percent vs. 80 percent) and a shorter length of pharmacologic treatment than those that were not breastfed. Breastfed infants of mothers on buprenorphine showed no difference in NAS than those not breastfed. Although this study contributes to the belief that breastfeeding has a positive effect on NAS symptoms, the study had some limitations. The 124 infants studied were born at 18 different locations where data was collected through questionnaires, personal, and telephone interviews. Nursing staff completed a questionnaire based on available medical data. Because the study was a retrospective design of the interviews over the prenatal and postnatal periods, the possibility exists that inaccurate or incomplete information was obtained.

Abdel-Latif and colleagues[15] conducted a retrospective chart review of 190 drug-dependent mothers and their infants admitted between 1998 and 2004. Infants were either breastfed ($n = 85$) or formula-fed ($n = 105$), and the Finnegan scoring tool was used to monitor withdrawal. Pharmacologic treatment was initiated if the score was 8 or higher. The results showed a statistically significant decrease in the need for pharmacologic treatment in the breastfed group ($p < .001$), withdrawal symptoms appeared later in the breastfed group (10 vs. 3 days, $p < .001$), and the dosage of medication required was lower in the breastfed group as well as the duration of treatment was shorter in the breastfed group (approximately 20 days shorter). The influence of unidentified drug usage by the mother and a high number of premature infants in the formula group could be considered limitations to this study. Premature infants have been shown to have fewer withdrawal symptoms compared with full-term infants because of developmental immaturity. Although this study had a large sample size and statistically significant results, it still relies on information that was obtained through chart review and therefore is subject to the possibility of missing or inaccurate documentation of information.

In a retrospective chart review by McQueen and colleagues,[14] 28 infants, who were exposed to methadone in utero and exhibited signs of NAS, were divided into three groups based on feeding method (8 were predominantly breastfed, 11 were combination-fed, and 9 were predominantly formula-fed). NAS scores were obtained from the charts and compared based on feeding method. The studies showed that fewer NAS scores were recorded on the predominantly breastfed group (69) compared with the other two groups (141 and 145, respectively) with a statistically significant difference between the groups ($p = .001$) suggesting that symptoms of NAS did not last as long in the breastfeeding group. The predominantly breastfed group also had significantly lower magnitude scores (meaning on average a lower severity of symptoms) than the other two groups ($p = .0001$). In the predominantly breastfed group, 17 percent required pharmacologic treatment for NAS symptoms compared with 38.8 percent in the formula-fed group and 40.2 percent in the combination-fed group.

Limitations to this study included nonrandomization (feeding method was chosen by mothers), small group sizes, self-report of methadone use, and possible instrument bias

because the researchers used the modified Finnegan scoring tool. The reliability of this tool had not been previously established. Considering the magnitude of the limitations, this study would be beneficial if conducted on a larger scale and with instrumentation shown to be reliable.

Isemann and colleagues[9] conducted a retrospective review, over a five-year period, of 128 infants that received methadone therapy for NAS in a university hospital. The researchers were exploring the effects of breastfeeding on methadone requirements. They found infants who were breastfed had shorter lengths of hospital stays than infants who were not breastfed (median 12.5 vs. 18.5 days, $p = .01$). Although this study was significant, it was open to inconsistencies. The charting was inconsistent and of unequal quality. The data relied on the mother's self-report of methadone dose with no reliability recorded. The instrument used to assess NAS scores was the Finnegan abstinence scoring method, which is a subjective assessment tool, open to interpretation by the scorer.

Ballard[12] showed that breastfeeding decreased the length of stay in the hospital for newborns exposed to substances in utero. Ten infants were studied in the clinical trial. Eight were exclusively breastfed and two were combination fed. The combination group had a six-day hospital stay. The breastfed exclusively group have stays ranging from two to five days. Although a small trial, it supported the researchers theory that breastfeeding can improve the severity of NAS. Several limitations exist in this study: very small sample size, all infants were breastfed at some point and therefore could not be compared with formula-fed infants, and there was no statistical data provided. This study seems like a good preliminary start for conducting a larger, statistically based research study.

Positioning

Maichuk and colleagues[17] questioned the beneficial use of prone positioning in narcotic-withdrawing newborns. All neonates were assessed using the neonatal abstinence scoring system (NASS), and infants with a score ≥5 were randomly assigned to one of two groups: prone- or supine-lying group (25 neonates were assigned to the prone group and 23 were assigned to the supine-lying group). The study showed that the supine-lying group had significantly higher peak and higher mean NASS scores than the prone-lying group ($p < .0001$). The study showed that highly agitated infants are less agitated when placed in the prone position for sleeping.

The NASS does not allow for case-blind evaluation. This is a potential limitation because it can lead to observer bias. The lack of information regarding the total amount of drug exposure and the specific types of drugs the infants were exposed to prior to birth is another limitation noted. Further research into this intervention could strengthen this potential management therapy and possibly allow for use of an easily administered intervention to be added to the standard care of infants with NAS.

Rooming-in

Three studies were found that supported the theory that rooming-in can lessen the pharmacologic treatment requirements for a newborn with NAS. In a 2012 retrospective study of 295 neonates, the researchers reviewed the medical records for a three-year period of opiate-exposed newborns and their mothers, who participated in the rooming-in program at British Columbia Women's Hospital (BCWH). The study showed that fewer newborns required pharmacologic treatment for NAS in the rooming-in group than the group that did not room in. The study further suggested that the neonates in the rooming-in program do not develop withdrawal symptoms to the same degree as the neonates in the standard care nursery.[18]

This study did not examine the varying combinations and types of drugs used by the mothers. No correlations were drawn between these two variables (drug types and the severity of the infant's withdrawal symptoms). Therefore, no conclusions can be stated regarding specific drugs or combinations of drugs in relation to NAS symptoms.

A retrospective cohort study in British Columbia examined three groups of mothers who had disclosed use of heroin or methadone and whose newborns were admitted to a standard care nursery or a Level II nursery for treatment of NAS symptoms.[8] The rooming-in group consisted of 32 women from BCWH. The first comparison group consisted of 38 women who delivered prior to the initiation of rooming-in at BCWH. The second comparison group consisted of 36 women who delivered at a nearby community hospital and received standard care. In both comparison groups, the newborns were kept in the standard care nursery during the first week of life. All infants were monitored daily for symptoms of NAS using the Finnegan scale. The nurses were trained in the use of the scale and the reliability coefficient was 0.82. The results showed a statistically significant difference in the groups. The infants in the rooming-in group required fewer days of morphine treatment, had shorter stays in the hospital, and had fewer admissions to a Level II or III nursery compared with the two control groups. A limitation of this study was random allocation. The authors allocated infants to groups by randomly choosing every third chart. This random allocation limited the sample size of the groups.

In a 2010 retrospective comparative review, researchers looked at 952 newborns of mothers who used substances during pregnancy and who delivered between October 1, 2003 and December 31, 2006.[19] One group ($n = 355$) of women delivered at BCWH where a rooming-in program was already established. The second group ($n = 597$) of women delivered elsewhere in British Columbia in which they received standard care only. On comparison, the researchers found that the rooming-in group had statistically significant lower odds of being admitted to the NICU fewer days in the NICU and a higher chance of being breastfed ($p < .001$) than the infants in the standard care group.

Limitations to this study included the lack of complete information on variables for each entry, the variation in reporting NAS symptoms between institutions, the lack of randomization between groups, and the lack of reliable reporting of the drugs that the mothers had used in pregnancy.

A limitation for all three studies was that a large proportion of the infants in the rooming-in group were breastfed. Researchers found rooming-in was associated with a statistically significant lower need for treatment of NAS, a lower rate of admission to a neonatal intensive care nursery, and a decreased mean length of stay in the hospital compared with standard care in a nursery.[8,18,19] These studies were also limited to one site and one research team. Further study related to rooming-in and its potential effects on NAS management should be explored in other locations.

Acupuncture/Acupressure

Acupuncture is a traditional Chinese practice that involves placing needles in specified meridian points. Acupuncture has not been extensively studied in the neonatal population, although both acupuncture and acupressure have been studied in children as a method of pain control.[20] Acupressure involves the application of pressure at specific trigger points on the body. Like acupuncture, the trigger points correlate to the symptoms of the neonate.

Filippelli and colleagues[20] conducted a retrospective chart review of 54 newborns diagnosed with NAS during a 15-month period. These newborns were treated with noninsertive acupuncture (NIA) where seven acupuncture points on the head or limbs were used to apply pressure with the finger for five to ten seconds at each point. This treatment was initiated when symptoms of NAS occurred such as restlessness, poor feeding, and irritability. The researchers found that better feeding occurred in 8 infants, 28 infants showed improved quality of sleep, and 13 were more relaxed after NIA. The researchers concluded that NIA is a viable option for treatment of the symptoms of NAS.

The study showed the potential for success of NIA in this population, but more studies with larger sample sizes are needed. Limitations to this study include a variation in detail of NIA in the charts; limited access to NIA treatment to one day per week when the acupuncture students with preceptor were available; missing data on NAS scores; and the fact that these infants were already on medication to treat the NAS symptoms, so definitively concluding that NIA reduced their NAS symptoms could not be stated. Limitations to the treatment include cost and availability of a trained acupuncturist.

Schwartz and colleagues[21] conducted four years and five months, randomized, prospective, but unblinded study of 76 neonates exposed to heroin and methadone in utero. Auricular acupressure was used in addition to standard care. Thirty-seven infants were assigned to the control group, and 39 assigned to the acupressure group. A small herbal seed was taped to left or right ear acupressure points based on symptoms the infant was exhibiting at time of placement. Bedside nurses documented NAS scores every two to four hours. The nurses were instructed to massage the area where the seeds resided for 30–60 seconds after each scoring event. Seeds were relocated to the opposite ear every 24–48 hours. Although the results were not significant, the data showed that fewer acupressure infants required pharmacologic support for NAS symptoms (76.9 percent vs. 86.5 percent), and the length of time on medications was only slightly different in the acupressure group (21.1 days vs. 21.9 days).

The study showed that auricular acupressure was safe and feasible in this population. No adverse effects were reported, and the successful level of recruitment was 96 percent. Limitations to this study include the possibility that the control group mothers massaged their infants' acupressure points in addition to the nurse-driven intervention, the most beneficial acupressure points may not have been selected, the correct sites may not have been chosen because of lack of data, only one ear was done at a time to minimize skin damage, and it is possible that the treatment was initiated too late in the NAS course. Further study with a larger sample size and correction of limitations in this study could be beneficial in proving the effectiveness of acupressure in NAS infants.

Specialized Beds

Two studies examined different beds for the use in NAS infants. Oro and Dixon[22] examined 30 narcotic-exposed neonates who were randomly assigned to nonoscillating waterbeds and half to standard bassinets. The neonates were assessed for NAS symptoms using the Finnegan scoring scale. The researchers concluded that the neonates on the waterbeds required less medication to control symptoms ($p = .02$) and their course of NAS was less severe ($p = .04$). The researchers also concluded that the infants appeared to settle to sleep easier and move less while on the waterbed. In conclusion, the researchers stated that the nonoscillating waterbeds used in this study were commercially available, cost less than the standard bassinet, were safe, noninvasive, and effective in treating symptoms of NAS. Limitations to this study include the small sample size. Strengths to the study include the lack of infant exposure to medications through breastfeeding and the uniform training of nurses in the use of the Finnegan scoring scale. Further studies are needed with a larger sample size to conclusively support this treatment modality.

In a repeated measures experimental design by D'Apolito,[23] 14 drug-affected infants were randomly assigned to a standard bed or a rocking bed. At 24 hours of age, infants were randomly assigned to a group and monitored for six days. Every three hours, scores for NAS were obtained. On Days 3 and 7, the Brazelton Neonatal Behavioral Assessment Scale was performed by a trained observer. The analysis of variance (ANOVA) revealed significant findings on Day 7 regarding NAS withdrawal scores. The rocking bed group showed an increase in NAS scores as well as an increase in sleep disturbance compared with the standard bed group.

The researchers concluded that the rocking motion and/or the settings on the rocking bed contributed to the results. Another limitation to the study was the small sample size. A repeated measures study with a larger sample size and a greater variety in setting options on the rocking bed may produce a more positive outcome.

Although both of these studies are dated, the study conducted using the nonoscillating waterbed showed the potential of this intervention in the NAS population. Further studies would be beneficial to potentially demonstrate the feasibility and application of this type of intervention to the population discussed. Waterbeds as an intervention could potentially be employed in any site that serves the needs of the NAS infant with minimal need for lengthy training to implement.

DISCUSSION

The purpose of this review was to determine the varying types of nonpharmacologic management being used for the treatment of NAS. There was a great deal of literature relating to pharmacologic treatment of NAS. We did not find any data on nonpharmacologic management of NAS alone. All articles retrieved combined pharmacologic and nonpharmacologic management, and there were limitations with these articles and in the ability to generalize the findings. The larger studies found were retrospective in design and the longitudinal studies had very small sample sizes. Half of the articles were dated which is an important consideration when examining the findings. These issues may limit the ability to apply the findings to practice, but this review both provides some general information and indicates some gaps in information and areas for future research.

The most significant finding of this review is that there is clearly a lack of information relating to nonpharmacologic management of NAS—and that the information that is available is difficult to generalize; however, there is some support in the literature for preemptive treatment with nonpharmacologic therapies in suspected cases of NAS.[2,26] Infants with NAS should be breastfed or offered breast milk if available because breastfeeding is associated with decreased severity of NAS symptoms and decreased pharmacologic requirement.[12,26–29] Prone positioning was shown to be effective in treating NAS and a technique that could be used in the nursery setting.[17] Rooming-in should be encouraged because it is associated with a decrease in required treatment, decrease in admission to NICU, and a decrease in length of stay.[8,18,19] Acupressure could be a potential treatment but requires further study to be conclusive. Placing an infant on a nonoscillating waterbed could potentially aid in a positive sleep cycle for the infant.[22]

Fourteen articles were found that discussed nonpharmacologic management of NAS in the presence of pharmacologic treatment. They were dated from 1988 to 2013 and included articles from Australia, Canada, United Kingdom, Norway, and the United States. Four were retrospective cohort studies, two were clinical trials, one was a repeated measures experimental design, one was a retrospective comparative review, one was a clinical observation, and five were retrospective chart reviews with rating system levels for hierarchy of evidence ranging from 2 to 4. Six studies were included on breastfeeding as an intervention with one study showing statistically significant results, and the other five showing positive results in decreasing the symptoms of NAS, withdrawal time, shorter length of pharmacologic treatment, and shorter length of hospital stays. One article discussed prone positioning in decreasing the severity of NAS symptoms. Three articles discussed rooming-in with two of the studies showing statistically significant results and the third showing a decrease in withdrawal symptoms. Acupuncture/acupressure was discussed in two articles, and although neither showed significant results, they did show the feasibility of using this intervention in the NAS population in future studies. Two articles discussed bed types with the waterbed showing a decrease in symptoms in this population.

The four randomized trials reviewed had small sample sizes with only one providing statistical analyses of the results. Although the results were positive in three out of four studies, larger sample sizes, further randomized control trials, and longitudinal studies for all of the interventions discussed are needed to gain depth of insight and clarity into the potential of these interventions in the NAS population. The studies reviewed with larger sample sizes were limited to retrospective reviews. This type of research inhibits randomization, potentially lacks inclusion of crucial data, and may not have provided for potential bias in scoring a priori.

With the total of only 14 articles discussing nonpharmacologic management of NAS, the need for future research in this area appears evident. Thirteen of the 14 articles reviewed showed that nonpharmacologic management of NAS had a positive effect on the infants with NAS. Although many are dated, used chart reviews as a design method, or had small sample sizes, the overall positive effects of these interventions should encourage further study. These studies need to be repeated in different centers with greater sample sizes and with subjects of different cultures, ethnicities, and socioeconomic status. The potential of one day managing NAS without pharmacologic intervention at all should spur the implementation of this research because pharmacologic therapy is costly and carries the potential of side effects. At present, no articles were found that discussed nonpharmacologic management of NAS as a sole therapeutic modality.

There are many options for the nonpharmacologic management of NAS infants. Nurses who work with this population should advocate for the use of nonpharmacologic interventions discussed in this review when possible. Many of these interventions could be incorporated as standard nursery care for NAS infants. As advocates for this special population,

nurses should employ or advise the use of nonpharmacologic interventions to decrease the potential complications of NAS and to provide these newborns with a possible alternative to pharmacologic management alone.

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