Am J Transl Res 2022;14(10):7233-7238
www.ajtr.org /ISSN:1943-8141/AJTR0143007

Original Article

Clinical efficacy of magnetotherapy combined with pediatric massage on infantile colic

Zhongli Xie, Hong Hong

Department of Pediatrics, The First Affiliated Hospital of Gannan Medical University, Ganzhou 341000, Jiangxi, China

Received March 21, 2022; Accepted September 1, 2022; Epub October 15, 2022; Published October 30, 2022

Abstract: Objective: To investigate the short-term and long-term efficacy of magnetotherapy and pediatric massage in the treatment of infantile colic. Methods: A total of 120 neonates with sudden onset crying, bloating, and breast refusal who met the diagnostic criteria for colic were retrospectively enrolled from September 2019 to September 2021. They were divided into a combination group, a magnetotherapy group, a pediatric massage group, and a control group based on different treatment methods (n=30 in each group). All cases were provided with conventional nursing. Results: The short-term efficacy of the combination group was significantly better than that of the control group. The difference was not statistically significant among combination, magnetotherapy, and pediatric massage groups (P>0.05). In the long-term efficacy assessment, the total effective rate was 96.67% in the combination group, 93.33% in the magnetotherapy group, 86.67% in the pediatric massage group, and 93.33% in the control group. There was no significant difference among the groups (P>0.05). Neonates in the combination group had the shortest crying relief time and the longest sleep duration after relief. This was followed by the magnetotherapy and the pediatric massage groups (P<0.05). Neonates in the control group had longer crying relief time and shorter sleep duration after relief than those in the combination group (P<0.05). From day 2 to day 7 of intervention, the pain level of the combination group was decreased significantly. This was significantly lower than that of the control group (P<0.05). Conclusion: Magnetotherapy combined with pediatric massage can improve neonatal colic, relieve crying and pain symptoms, and improve sleep quality.

Keywords: Magnetotherapy, pediatric massage, neonates, infantile colic, pain, clinical efficacy

Introduction

Infantile colic, known as neonatal colic, is a benign, self-limiting functional gastrointestinal disorder. It is a common symptom of acute abdominal pain in pediatric patients, mostly caused by paroxysmal strong contractions of the intestinal smooth muscle [1]. The disorder is related to the gastrointestinal tract. Most children have no physiological structural or biochemical abnormalities. Its etiology is related to excessive intestinal gas, increased intestinal peristalsis, abnormal gastrointestinal hormone secretion, and dietary abnormalities [2]. Children with intestinal spasms often exhibit persistent crying, vomiting, abdominal distention and tension, rolling over, flushed cheeks, and leg flexion. Relief occurs after passing gas out of the back passage [3]. Intestinal spasms can interfere with newborn feeding. Excessive crying can interfere with the development of a good mother-infant relationship and increase the risk of caregiver depression. This can be a key cause of breastfeeding disruption [4].

There is no clear standard for the management of infantile colic. The available treatment option is mainly symptom improvement. Western medicine advocates nursing, feeding, medication or probiotic supplementation as interventions. These therapies have not been recognized as evidence-based and have shown poor efficacy [5, 6]. Infantile colic belongs to the category of "abdominal pain" in traditional Chinese medicine. It was first described in the book "Hundred Questions for Infants" in the Ming Dynasty. This book described the etiology and pathogenesis of infantile colic. It advocated that both internal and external therapies need to be performed in the treatment of the condition. Magnetotherapy

is an intervention which uses artificial magnetic fields to act on meridians, acupuncture points, and lesions to improve symptoms. Previous studies in recent years have shown that magnetotherapy is effective in treating insomnia, phlebitis, and cervical spondylosis [7, 8]. Massages are traditional Chinese medical treatment. They are interventions of the practitioner using his or her hands by pushing, holding, pressing, and pinching the body surface of the patient. The aim of massage is to dredge the meridians, promote Qi and blood, and harmonize Yin and Yang. Studies have confirmed that massages have a good effect on pediatric fever and cough [9, 10]. There are many studies on the clinical efficacy of massage, but only a few studies on the combined application of magnetotherapy and massage in infantile colic. This study integrated the above intervention methods to investigate the feasibility of magnetotherapy combined with pediatric massage. This intervention provides new treatment methods for relieving infantile colic. This study provided data for improving the clinical symptoms of infantile colic.

Materials and methods

General data

In this retrospective study, conducted from September 2019 to September 2021, clinical data included 120 neonates with sudden onset crying, bloating, and breast refusal. These neonates met the diagnostic criteria for colic according to the Rome IV Criteria for Functional Gastrointestinal Disorders in infants. They were enrolled and divided into a combination group, a magnetotherapy group, a pediatric massage group, and a control group according to different treatment methods (n=30 for each group). The study was approved by the ethics committee of the First Affiliated Hospital of Gannan Medical University (NCT01532657).

Inclusion criteria: (1) the neonates diagnosed with colic according to the Rome IV Criteria for Functional Gastrointestinal Disorders in infants and presented with the corresponding clinical symptoms; (2) the neonates with complete medical records.

Inclusion criteria for the control group: the neonates born in our hospital with symptoms of colic without special interventions.

Exclusion criteria: (1) neonates with congenital diseases such as congenital heart disease; (2) neonates included in unfinished clinical studies; (3) neonates with Apgar score at birth ≤8 [11]; (4) neonates with a history of intrauterine distress; (5) neonates diagnosed with surgical acute abdomen; (6) neonates who were not hospitalized.

Intervention methods

All neonates were provided with routine nursing. The following procedures were performed in the combination group. (1) Auricular magnetic ear pellets (Suzhou Medical Supplies Co., Ltd.). One pellet was placed at bilateral Tianshu acupoints and bilateral Feosanli acupoints of the neonate and fixed with adhesive tape for 2 h each time. Two sessions were performed twice a day, with appropriate pressure on the beads during episodes of abdominal pain and crying. (2) Reinforcing Pitu. The Pitu acupoint is located on the radial side of the thumb. The primary nurses used the radial side of the thumb to push along the radial side of the child's left thumb from the fingertip to the bottom of the finger, 100 to 300 times for one session. (3) Massage. The abdomen was massaged clockwise for 3 min, and the umbilicus was rubbed for 2 min, followed by massaging from the radial side of the forearm, transverse crease of the wrist to the transverse cubital crease in a straight line for 1 min. The magnetotherapy group received the same magnetotherapy as the combination group. The pediatric massage group was provided with the same massage procedures as the combination group. The control group was provided with comfort, embrace, and hot compresses on the abdomen. The duration of intervention was 7 d for all four groups.

Outcome measurement

(1) The short-term and long-term efficacy of the four groups were classified as cured, improved, and ineffective. Cured referred to the disappearance of abdominal pain symptoms, the resumption of normal breastfeeding, and defecation. Improved referred to the reduction in the frequency and duration of abdominal pain episodes. Ineffective referred to no improvement in pain symptoms. Effective rate = (cured cases + improved cases)/total number of cases × 100%. The short-term efficacy was evaluated

Table 1. Comparison of baseline data (χ±s)/[n (%)]

General data		Combination group (n=30)	Magnetotherapy group (n=30)	Pediatric massage group (n=30)	Control group (n=30)	*F*	*P*
Gender	M	17	18	15	16	0.132	0.716
	F	13	12	15	14		
Average gestational age (months)		38.90±2.19	39.11±1.98	38.98±2.11	39.10±1.78	0.075	0.973
Mean age in days (d)		3.21±0.12	3.22±0.11	3.19±0.21	3.20±0.19	0.187	0.905
Mean weight (kg)		3.87±0.32	3.89±0.29	3.91±0.30	3.87±0.29	0.122	0.947
Apgar score		9.81±0.17	9.80±0.18	9.79±0.19	9.78±0.20	0.146	0.932
Frequency of bowel movements		2.98±0.32	3.01±0.29	2.97±0.34	3.00±0.20	0.117	0.95
Duration of crying (h)		4.49±0.87	4.51±0.88	4.53±0.90	4.50±0.88	0.011	0.998

after 7 d of intervention. The long-term efficacy was evaluated at 6 months of follow-up.

(2) The improvement of symptoms in the four groups was recorded. The crying relief time (the time from the beginning of crying to the end of cry) and sleep duration after relief (the average sleep time of neonates within 7 d after relief) were recorded.

(3) The improvement of the pain level in the four groups after intervention was evaluated using the scoring method [12]. A 0 for no abdominal pain and no crying, 1 for mild abdominal pain, less frequent attacks, 2 for moderate abdominal pain and crying that was alleviated after comfort, and 3 for severe abdominal pain, crying, and cold hands and feet. The neonates with abdominal pain were presented as restlessness, painful face, paroxysmal crying, serious case with pale face, cold sweat, and even shock symptoms.

The recording and evaluation of all the indicators were completed by the primary nurses of neonates.

Statistical analysis

SPSS24.0 statistical software was used to analyze the data. GraphPad Prism 8.3 was used as the graphing software [13]. The normality of quantitative data was examined using the Kolmogorov-Smimov test. Indicators conforming to normal distribution were analyzed by the independent-sample t-test (two groups) or analysis of variance (ANOVA) (three or more groups). The post-hoc comparisons were performed by SNK test, with results presented as mean ± standard deviation. The count data were expressed as percentage. The chi-square test was used for inter-group comparison. The difference was statistically significant at $P<0.05$.

Results

Comparison of baseline data

Baseline data for the four groups for inter-group comparisons included gender, gestational age, age in days, body weight, Apgar score, frequency of stools, and duration of crying. The results showed that the differences among the four groups were not statistically significant in terms of the above baseline data ($P>0.05$), indicating that the four groups were comparable (**Table 1**).

Differences in short-term outcomes

The short-term efficacy of the combination group was significantly better than that of the control group. The difference in short-term efficacy was not statistically significant among the combination, magnetotherapy, and pediatric massage groups ($P>0.05$) (**Table 2**).

Differences in the long-term efficacy

The differences in the long-term efficacy were not statistically significant among the combination, magnetotherapy, pediatric massage, and control groups ($P>0.05$) (**Table 3**).

Comparison of the improvement of symptoms

The results showed that the neonates in the combination group had the shortest crying relief time and the longest sleep duration after relief. This was followed by the magnetotherapy and pediatric massage groups. The neonates in the control group had the longest crying relief time and the shortest sleep duration after

Table 2. Differences in the short-term outcomes [n (%)]

Group	Number of cases	Markedly effective	Effective	Ineffective	Effective rate
Combination group	30	15 (50.00)	14 (46.67)	1 (3.33)	29 (96.67)
Magnetotherapy group	30	10 (33.33)	15 (50.00)	5 (16.67)	25 (83.33)
Pediatric massage group	30	11 (36.67)	15 (50.00)	4 (13.33)	26 (86.67)
Control group	30	2 (6.67)	22 (73.33)	6 (20.00)	24 (80.00)
χ^2	-	-	-	-	15.353
P	-	-	-	-	0.018

Table 3. Differences in long-term outcomes of treatment [n (%)]

Group	Number of cases	Markedly effective	Effective	Ineffective	Effective rate
Combination group	30	15 (50.00)	14 (46.67)	1 (3.33)	29 (96.67)
Magnetotherapy group	30	10 (33.33)	18 (60.00)	2 (6.67)	28 (93.33)
Pediatric massage group	30	11 (36.67)	15 (50.00)	4 (13.33)	26 (86.67)
Control group	30	2 (6.67)	26 (86.67)	2 (6.67)	28 (93.33)
χ^2					13.000
P					0.369

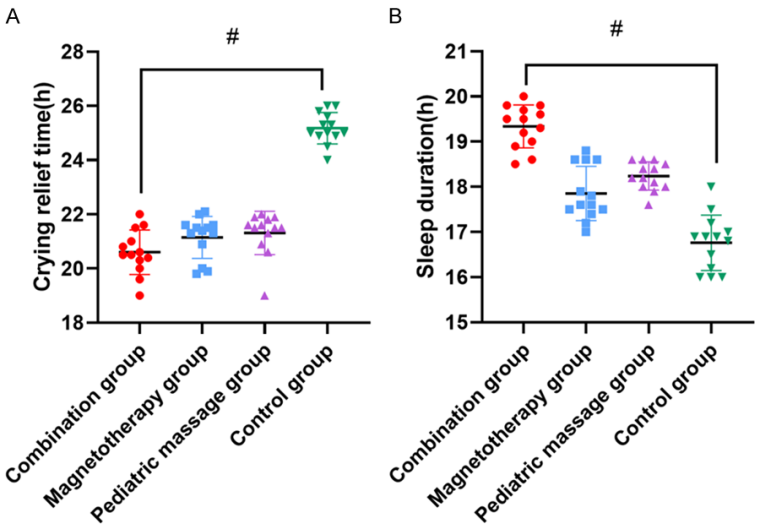

Figure 1. Comparison of symptom improvement. A: Crying relief time, B: Sleep duration after relief. Compared with the control group, #*P*<0.05.

relief. The difference of crying relief time and sleep duration after relief between the combination group and the control group was statistically significant (*P*<0.05). The difference among the combination, magnetotherapy, and pediatric massage groups was not statistically significant (*P*>0.05) (**Figure 1**).

Improvement of pain level among the four groups

Before the intervention, there was no significant difference in the pain level among the four groups (*P*>0.05). From the 2nd to the 7th day of intervention, the pain level in the combination group decreased significantly. This was significantly lower than that in the control group (*P*<0.05) (**Figure 2**).

Discussion

An intestinal spasm is one of the common types of acute abdominal pain in neonates. It is mainly caused by the contraction of the smooth muscle in the intestinal wall and has a great impact on the feeding of neonates [14]. The main manifestation of infantile colic is recurrent abdominal pain. This can affect the quality of sleep and cause anxiety and tension in parents if the child's symptoms are not relieved. It can lead to serious complications [15]. The current treatment options for infants with colic in western medicine mainly include dietary changes, pharmacological antispasmodics, and hot compresses on the abdomen. They are ineffective and have a high incidence of side effects, making it urgent to find a more effective intervention to improve the prognosis of infants [16].

In this study, the effect of magnetotherapy and pediatric massage on infantile colic was ana-

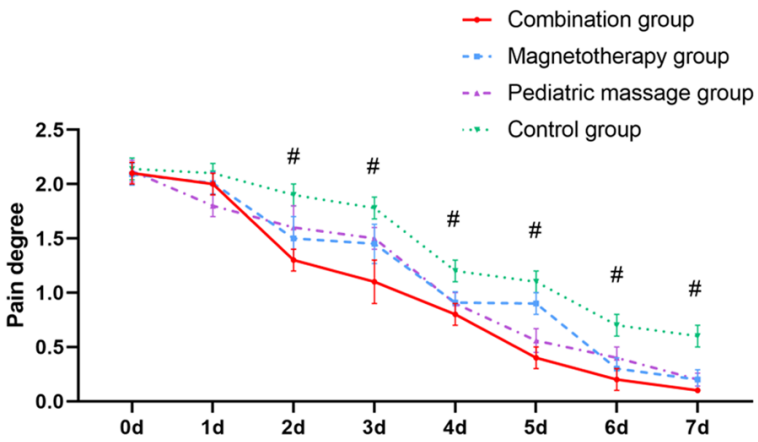

Figure 2. Improvement of pain level in four groups. There was a statistically significant difference between the combination group and the control group, #*P*<0.05.

lyzed by adopting grouping and comparison methods. The results showed that neonates in the combination group who received combined magnetotherapy and pediatric massage had better clinical outcomes. The efficiency effective rate of 96.67% compared with 80.00% in the control group. A study of 51 children with infantile colic showed that the total effective rate of massage treatment was 93.33%. This was higher than 76.67% of conventional nursing [17]. Another study of 60 children with infantile colic found that the total effective rate of massage treatment was 96.67%. This was higher than 73.33% of conventional treatment [18]. The findings of the above studies are like this study. Magnetotherapy is an emerging therapy. Auricular acupoint sticking is a traditional Chinese medical treatment. The auricular magnetotherapy has the characteristics of low cost, simple operation, safe, non-invasive, and less side effects compared with other interventions, which is more suitable for newborns [19, 20]. Traditional Chinese medicine believes that auricular acupoint sticking can adjust the excitatory balance of the vegetative nerves, unblock the Qi flow, and facilitate the diuresis, achieving good outcomes [21]. The massage therapy in this study is safer than acupuncture and umbilical compress therapy. Massage can help accelerate the establishment of gastrointestinal function in newborns, evacuating and ventilating Qi [22]. This was reflected in the indicator of the shortest time of abdominal pain relief in the combination group. In the study, the effects of different interventions on pain level of neonates with colic were recorded. The results showed that the pain level scores of the combination group had a decreasing trend. This was higher than that of the magnetotherapy and pediatric massage groups. Neonates in the control group showed the smallest decrease of the pain level scores. It differed significantly from the combination group. In a study of neonates with intestinal spasms, massage was found to help prolong the sleep duration of the neonates (16.59±2.11) h vs. (18.11±2.29) h [23]. This reflected the results of the present study. Massage stimulates the skin receptors of newborns in a gentle manner, bringing a feeling of safety and comfort in newborns. The stimulation, with postural changes, facilitate the discharge of intestinal gas and secretions of newborns, beneficial to their postural drainage and lung development [24].

Magnetotherapy combined with pediatric massage can improve infantile colic, relieve the crying and pain symptoms, and improve their sleep conditions. The novelty of this study was to demonstrate the feasibility of combining magnetotherapy and pediatric massage in neonates and to quantify the effectiveness of the intervention by comparing the groups. The shortcoming of this study was that the source of study subjects was relatively single, leading to biased results. It is proposed to conduct a larger sample and multi-center study to verify the data in the later stage.

Disclosure of conflict of interest

None.

Address correspondence to: Hong Hong, Department of Pediatrics, The First Affiliated Hospital of Gannan Medical University, No.23, Qingnian Road, Zhanggong District, Ganzhou 341000, Jiangxi, China. Tel: +86-13479466602; E-mail: honghong6602@163.com

References

[1] Indrio F, Dargenio VN, Giordano P and Francavilla R. Preventing and treating colic. Adv Exp Med Biol 2019; 1125: 49-56.

[2] Ong TG, Gordon M, Banks SS, Thomas MR and Akobeng AK. Probiotics to prevent infantile colic. Cochrane Database Syst Rev 2019; 3: CD012473.

[3] Daelemans S, Peeters L, Hauser B and Vandenplas Y. Recent advances in understanding and managing infantile colic. F1000Res 2018; 7: F1000 Faculty Rev-1426.

[4] Hojsak I. Probiotics in functional gastrointestinal disorders. Adv Exp Med Biol 2019; 1125: 121-137.

[5] Ouald Chaib A, Levy EI, Ouald Chaib M and Vandenplas Y. The influence of the gastrointestinal microbiome on infant colic. Expert Rev Gastroenterol Hepatol 2020; 14: 919-932.

[6] Rhoads JM, Collins J, Fatheree NY, Hashmi SS, Taylor CM, Luo M, Hoang TK, Gleason WA, Van Arsdall MR, Navarro F and Liu Y. Infant colic represents gut inflammation and dysbiosis. J Pediatr 2018; 203: 55-61, e53.

[7] Korpela K, Renko M, Paalanne N, Vänni P, Salo J, Tejesvi M, Koivusaari P, Pokka T, Kaukola T, Pirttilä AM and Tapiainen T. Microbiome of the first stool after birth and infantile colic. Pediatr Res 2020; 88: 776-783.

[8] Loughman A, Quinn T, Nation ML, Reichelt A, Moore RJ, Van TTH, Sung V and Tang MLK. Infant microbiota in colic: predictive associations with problem crying and subsequent child behavior. J Dev Orig Health Dis 2021; 12: 260-270.

[9] Raak C, Krueger P, Klement P, De Jaegere S, Weber S, Keller T, Ilyenko L, Martin D and Ostermann T. Effectiveness of a homeopathic complex medicine in infantile colic: a randomized multicenter study. Complement Ther Med 2019; 45: 136-141.

[10] Underwood MA. Should we treat every infant with a probiotic? Minerva Pediatr 2019; 71: 253-262.

[11] Skonieczna-Żydecka K, Janda K, Kaczmarczyk M, Marlicz W, Łoniewski I and Łoniewska B. The effect of probiotics on symptoms, gut microbiota and inflammatory markers in infantile colic: a systematic review, meta-analysis and meta-regression of randomized controlled trials. J Clin Med 2020; 9: 999.

[12] Bozzi Cionci N, Baffoni L, Gaggìa F and Di Gioia D. Therapeutic microbiology: the role of bifidobacterium breve as food supplement for the prevention/treatment of paediatric diseases. Nutrients 2018; 10: 1723.

[13] Salvatore S, Pensabene L, Borrelli O, Saps M, Thapar N, Concolino D, Staiano A and Vandenplas Y. Mind the gut: probiotics in paediatric neurogastroenterology. Benef Microbes 2018; 9: 883-898.

[14] Vandenplas Y, Gerlier L, Caekelbergh K, Nan Study G and Possner M. An observational real-life study with a new infant formula in infants with functional gastro-intestinal disorders. Nutrients 2021; 13: 3336.

[15] Savino F, Galliano I, Garro M, Savino A, Daprà V, Montanari P and Bergallo M. Regulatory T cells and toll-like receptor 2 and 4 mRNA expression in infants with colic treated with lactobacillus reuteri DSM17938. Benef Microbes 2018; 9: 917-925.

[16] Aloisio I, Prodam F, Giglione E, Bozzi Cionci N, Solito A, Bellone S, Baffoni L, Mogna L, Pane M, Bona G and Di Gioia D. Three-month feeding integration with bifidobacterium strains prevents gastrointestinal symptoms in healthy newborns. Front Nutr 2018; 5: 39.

[17] Aparicio M, Alba C, Cam Public Health Area PSGO, Rodríguez JM and Fernández L. Microbiological and immunological markers in milk and infant feces for common gastrointestinal disorders: a pilot study. Nutrients 2020; 12: 634.

[18] Halloran K and Underwood MA. Probiotic mechanisms of action. Early Hum Dev 2019; 135: 58-65.

[19] Hojsak I, Fabiano V, Pop TL, Goulet O, Zuccotti GV, Çokuğraş FC, Pettoello-Mantovani M and Kolaček S. Guidance on the use of probiotics in clinical practice in children with selected clinical conditions and in specific vulnerable groups. Acta Paediatr 2018; 107: 927-937.

[20] El Hasbaoui B, Karboubi L and Benjelloun BS. The role of abdominal ultrasound in the management of excessive crying in infants. Pan Afr Med J 2018; 30: 68.

[21] Zhang Y, Cong D, Liu P, Zhi X, Shi C, Zhao J and Zhang H. Study on the mechanism of regulating the hypothalamic cortical hormone releasing hormone/corticotropin releasing hormone type I receptor pathway by vibro-annular abdominal massage under the brain-intestine interaction in the treatment of insomnia. Medicine (Baltimore) 2021; 100: e25854.

[22] Gao H, Zhang X, He W, Zhao X, Han J, Li D, Yang H and Li S. To study the intervention mechanism of pediatric massage on intestinal flora and host metabolism in children with anorexia. Medicine (Baltimore) 2020; 99: e23349.

[23] Zhou KL, Dong S, Guo S, Dai XH, Yang JY, Liu Y, Mi BL, Wang SW, Fu GB and Wei PD. Efficacy and safety of massage therapy for chronic atrophic gastritis: a protocol for systematic review and meta-analysis. Medicine (Baltimore) 2020; 99: e23347.

[24] Zhang W, Li H, Zhao N, Luo X, Liu S, Bao A, Chen Y, Wang H, Wang J and Wang J. Lactobacillus johnsonii BS15 combined with abdominal massage on intestinal permeability in rats with nonalcoholic fatty liver and cell biofilm repair. Bioengineered 2021; 12: 6354-6363.