Rapid Reviews in Paediatric Integrative Medicine

Massage therapy for paediatric procedural pain: A rapid review

Kylie Bernstein MD, Mohammad Karkhaneh PhD, Liliane Zorzela, MD PhD, Hsing Jou MD, Sunita Vohra MD MSc[®]

Department of Pediatrics, Faculty of Medicine and Dentistry, University of Alberta, Edmonton, Alberta

Correspondence: Sunita Vohra, Department of Pediatrics, Faculty of Medicine and Dentistry, University of Alberta, 1702 College Plaza, 8215-112 Street NW, Edmonton, Alberta T6G 2C8. Telephone 780-492-6445, Fax 780-492-5883, e-mail svohra@ualberta.ca

Abstract

Background: Pain is a common paediatric problem, and procedural pain, in particular, can be difficult to manage. Complementary therapies are often sought for pain management, including massage therapy (MT). We assessed the evidence for use of MT for acute procedural pain management in children.

Methods: We searched five main databases for (i) primary studies in English, (ii) included children 0 to 18 years of age, (iii) compared MT for procedural pain management to standard care alone or placebo, and (iv) measured pain as the primary or secondary outcome. The data were extracted by one author and verified by a second author. Randomized controlled trials were evaluated using the Cochrane Risk of Bias tool.

Results: Eleven paediatric trials of procedural pain in neonatal, burn, and oncology populations, a total of 771 participants, were identified. Eight reported statistically significant reductions in pain after MT compared to standard care. Pain was measured using validated pain scales, or physiologic indicators. The studies were heterogeneous in population, techniques, and outcome measures used. No adverse events associated with MT were identified.

Conclusion: MT may be an effective nonpharmacologic adjunct for management of procedural pain in children.

Keywords: *Massage; Paediatrics; Pain.*

BACKGROUND

Inadequate procedural pain management is common in children (1). Neonates and older children are frequently subjected to painful procedures, yet surveys have found that procedural pain is suboptimally addressed, particularly in hospital settings, and is among the most difficult type of pain to manage (2–4).

Assessment and management of neonatal pain is particularly challenging, in part, because indirect behavioural and physiological indicators of pain must be used (5). Studies have shown that preterm neonates previously exposed to repeated painful stimuli have intensified responses to pain compared to term infants (5–7).

Studies in children also confirm the adverse effects of inadequately treated procedural pain on psychological well-being

(3), including its negative effects on developmental outcomes and long-term hyperalgesia (1). Stevens et al. looked at over 3800 children and adolescents hospitalized across Canada, and found that 33% reported moderate to severe acute pain. Furthermore, only 28.3% of children had at least one form of pain management (pharmacologic, physical, psychological support) administered and documented specifically for the painful procedure (3,8).

In an attempt to better manage procedural pain safely and effectively, complementary therapies are being sought as adjuncts to conventional pain management (9). Massage therapy (MT), defined as the manipulation of muscles and other soft tissues of the body to enhance health and well-being (10), is a popular

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complementary therapy (8,11). The mechanism of action of MT on pain is not well understood. There have been a number of hypotheses, including the Gate Theory of Pain Control, which theorizes that MT may stimulate large-diameter nerve fibres that inhibit input from the small-diameter nerve fibres that serve as pain receptors. Additionally, MT may also induce local biochemical changes in the soft tissues, causing improved oxygenation and blood flow, as well increasing the release of certain hormones involved in pain perception, such as oxytocin, endorphins, and serotonin (10). MT is gaining recognition as a potential adjunct for pain control in the acute paediatric setting.

OBJECTIVE

This review aims to assess the evidence for MT in the management of acute procedural pain in the paediatric population.

METHODS

Search and study selection

A literature search was conducted using MEDLINE, EMBASE, CINAHL, Cochrane Central Register of Controlled Trials, and Cochrane Database of Systematic Reviews. We also conducted citation searches and searched Google Scholar for additional studies. The search was limited to randomized controlled trials (RCTs) and controlled clinical trials (CCTs) published January 2000 through November 14, 2017 (Supplementary Appendix I). MT was defined as the manipulation of muscles and other soft tissues of the body to enhance health and well-being (10). The modalities included in this review were identified by the term 'massage', as referenced in our search terms. Some other interventions may include touch (e.g., reflexology), but were not included unless the intervention was specifically identified as MT. While reflexology is a form of tactile stimulation, MT and reflexology are two different modalities with different training, practice, and intent. Reflexology is performed by putting pressure specifically on trigger points or 'reflex zones' of the hands and feet that supposedly correspond to organs of the body, acting as both a relaxation and detoxification process. Massage is a different discipline, which has different training and uses different technique involving manipulation of entire muscle groups (12).

Trials were selected if they were: (i) primary studies in English, (ii) included children 0 to 18 years of age, (iii) compared MT for procedural pain management to standard care alone or placebo, and (iv) measured pain as the primary or secondary outcome.

Data collection and analysis

Data extraction and critical appraisal of RCTs/CCTs was conducted by one author (KB) and verified by another (MK). RCTs were evaluated using the Risk of Bias (RoB) tool from the

Cochrane Handbook on Systematic Reviews of Interventions (13). CCTs are at high risk of selection bias due to lack of randomization and concealment of allocation; therefore, we did not perform additional RoB assessments (14).

FINDINGS

We identified 11 clinical trials that used MT for procedural pain, evaluating a total of 771 participants including two trials in neonates (did not differentiate between preterm and term), three in preterm neonates, three in term neonates, two in paediatric burn patients, and one in paediatric oncology patients (Figure 1). Five studies used MT for heel stick, one for surgical tape removal, two for venipuncture, two for wound debridement and dressing, and one for intrathecal therapy (IT)/bone marrow aspiration (BMA). The sample sizes were 23 to 104 participants and age ranged from preterm neonates (30 weeks gestational age [GA]) to 18 years of age.

MT technique and location was heterogeneous. Studies varied in terms of whether massage was applied to the whole body, around the procedure area, or on the contralateral limb. All studies used MT as an adjunct to standard care. Standard care was defined by the individual unit (neonatal intensive care unit [NICU], burn, oncology) care plan for painful procedures, including pharmacotherapy, psychological support, or no intervention. The control groups used standard care in all included studies, except for Diego et al. (15) that also compared moderate pressure MT to a light pressure massage procedure described as 'stimulation placebo' in the study, defined as 'no skin color change in a Caucasian baby or indentation in skin for all infants' (15). In addition to standard care, some studies also compared MT to other nonpharmacological approaches, such as non-nutritive sucking (NNS) (16–18) or breastfeeding (17,19). Table 1 describes the type of standard care treatment (or lack thereof) used in each study.

Validated pain assessment scales for term and preterm neonates included the premature infant pain profile (PIPP) (16), douleur aigue du nouveau-ne (DAN) (17), and neonatal infant pain scale (NIPS) (18), in addition to physiologic indicators of pain, such as oxygen saturation (SaO_2), heart rate (HR), and respiratory rate. Measurement of pain in burn patients was performed using Children's Hospital of Eastern Ontario pain scale and a visual analogue pain scale, which was also used by cancer patients for IT/BMA (Table 1).

Neonates

Term and preterm neonates combined.

Two RCTs (19,20) evaluated the effectiveness of light pressure massage on neonates. One study performed by study investigator for 3 minutes, 2 minutes prior to venipuncture (19). The other study had trained NICU nurses provide massage to both upper limbs for 2 minutes, 5 minutes prior to venipuncture

*Adopted from Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement

Figure 1. PRISMA diagram of massge therapy for paediatric procedural pain*.

*Adopted from Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement.

(19). These trials looked at 115 healthy neonates, but did not differentiate preterm from term neonates; one study included neonates greater than 34 weeks GA (19) and the other greater than 30 weeks GA (20).

Both trials showed statistically significant reduction in pain scores favouring MT compared to usual NICU care (20) or compared to both no intervention and breastfeeding (19) (Table 2).

Term neonates.

Three RCTs (16–18) evaluated the effectiveness of MT for pain reduction during heel stick procedures in 293 healthy full-term neonates. Two studies compared MT to control (no intervention), as well as to NNS (16,18) and the third study compared MT to nonpharmacological health approaches, including expressed breast milk, sucrose, distilled water, NNS, and rocking (17).

The first trial, using firm but gentle pressure on the ipsilateral leg performed by one of the investigators, for 2 minutes prior to the procedure until completion, found that PIPP scores were lower

in the MT group, but there was no effect on physiologic measurements such as HR and SaO₂. PIPP scores were also lower in the NNS group compared to the control group; however, there was no statistically significant difference between NNS and massage groups (16). The second study found no effect of MT on DAN pain scores or vital signs using full body massage (six firm, gentle strokes to each area and continued in a cyclical manner) during and up to 2 minutes after the procedure. However, NNS and rocking were found to reduce DAN scores at 2 and 4 minutes post-intervention ($P < 0.05$). It was not specified in the study who performed the massage (17). The third study, applying a traditional Korean touching technique, Yakson ('healing hand') by mothers, for 1 minute prior to heel stick until completion, reported that MT significantly improved only SaO₂, not HR or NIPS compared to standard care, but did not differ from the NNS group (18) (Table 2).

Preterm neonates.

Three studies (two RCTs, one CCT) (15,21,22) focused on pain during surgical tape removal and heel stick in preterm

Table 1. General characteristics of studies on MT for procedural pain in paediatrics

First author (year), country	Study design	Number of participants	Age (mean, range)	Sex (male %)	Procedure	Setting	Intervention	Control	Dose/day
Zargham-Boroujeni (2017), Iran	RCT	75	30–40+ weeks GA	43%	Venipuncture	NICU	Light touch massage	Standard care (no intervention); breastfeeding	All venipuncture in NICU over 4-month period
Chik (2017), Hong Kong	RCT (cross-over)	80	30–40 weeks GA	53%	Venipuncture	NICU	Light pressure massage	Standard care (usual care)	All venipuncture in NICU
Celebioglu (2015), Turkey	CCT	25	4–15 years	60%	IT/BMA	Oncology unit	Massage avoiding injection site	Standard care (narcotics, benzos, barbiturates, EMLA)	All IT/BMA on oncology unit within 3-month period
Abdallah (2013), Lebanon	CCT	66	Mean GA 32 weeks	57%	Heel stick	NICU	Full body MT by mother	Standard care (does not specify)	For all heel sticks in NICU
Mirzarahimi (2013), Iran	RCT	90	3–6 days	60%	Heel stick	NICU	Leg massage	Standard care (no intervention); NNS	For all heel sticks in NICU
Guroi (2010), Turkey	CCT	63	12–18 years	54%	Wound debridement/dressing change	Burn unit	Massage healthy tissue around wounds	Standard care (analgesic, antipruritic, sedative)	MT twice per week for 5-week period
Diego (2009), USA	RCT	56	29.8–40.1 weeks GA	57%	Surgical tape removal	NICU	Moderate pressure massage	Light pressure massage 'stimulation placebo'; standard care (does not specify)	All surgical tape removal in NICU
Im (2008), Korea	RCT	99	Mean GA 39 weeks	47%	Heel stick	NICU	Yakson massage	Standard care (no intervention); NNS	For all heel sticks in NICU
Mathai (2006), India	RCT	104	Mean 44–48 h	50%	Heel stick	NICU	Full body massage	EBM, sucrose, DW, NNS, rocking	For all heel sticks in NICU
Jain (2006), Canada	RCT (cross-over)	23	1–7 days		Heel stick	NICU	Leg massage	Standard care (wrapped and bundled)	For all heel sticks in NICU

Table 1. Continued

First author (year), country	Study design	Number of participants	Age (mean, range)	Sex (male %)	Procedure	Setting	Intervention	Control	Dose/day
Hernandez-Reif (2001), USA	RCT	90	Mean 25–34 months	79%	Wound debridement/dressing change	Burn unit	Massage unaffected areas	Standard care (analgesic—acetaminophen with codeine or morphine IV/IM); attention control group (massage therapist present for the dressing changes)	For all wound debridement/dressing changes

CCT Controlled clinical trial; DW Distilled water; EMLA Eutectic Mixture of Local Anesthetics; GA Gestational age; IM Intramuscular; IT/BMA Intrathecal therapy and bone marrow aspiration; IV Intravenous; MT Massage therapy; NICU Neonatal intensive care unit; NNS Non-nutritive sucking; RCT Randomized controlled trial; Yakson A traditional Korean massage by mother putting her hand on the aching area of her child and caressing or massaging the area to relieve her child's discomfort.

infants. These studies included 131 otherwise healthy preterm (<37 weeks GA) infants.

Two studies, one using ipsilateral gentle leg massage administered by investigators for 2 minutes, 5 minutes prior to heel stick (21) and the other using 10 minutes of whole body moderate pressure massage administered by trained mothers for 10 minutes prior to heel stick (22), reported that MT significantly reduced NIPS, HR (20), and PIPP scores (22) during heel stick, compared to standard NICU care alone (Table 2). The third study used trained therapists, administering 15 minutes of moderate pressure massage followed by the procedure 15 minutes later. Maximum HR was significantly lower following surgical tape removal and returned to baseline faster in the MT group compared to control and light pressure massage 'stimulation placebo' groups (Table 2).

Burn patients.

Two studies (one RCT, one CCT) (23,24) evaluated the effects of MT on 87 children with burn injuries.

In Hernandez et al., application of moderate pressure MT by a trained therapist to unaffected body parts (face, arms, legs, back, shoulders) 15 minutes prior to burn dressing change significantly decreased five out of six parameters in the Children's Hospital of Eastern Ontario pain scale compared to standard care (analgesic administration) (23). Additionally, nurses reported less difficulty completing the dressing change, and massage therapists reported better relaxation in the MT group. Gurol et al. had trained massage therapists administer MT to healthy tissue around the burn for 15 minutes twice per week for 5 weeks, and reported significant reduction in pain, itching, and anxiety in MT patients compared to control (24) (Table 2).

Oncology patients.

Celebioglu et al. conducted the only trial (CCT) evaluating the effectiveness of MT in addition to standard care, which consisted of any combination of narcotics, benzodiazepines, barbiturates, and topical anesthetic cream (Eutectic Mixture of Local Anesthetics). The study assessed pain associated with IT and BMA in 25 paediatric oncology patients (25). A licensed infant massage therapist administered MT for 10 to 15 minutes immediately prior to the procedure, avoiding the injection site. There was significant improvement in post-test visual analogue pain scale scores in the MT group compared to standard care group (Table 2).

Adverse events

Five of the 11 studies reported no adverse events (18,21–23,25) while the other studies did not comment on adverse events (15–17,19,20,24).

Quality of evidence

Risk of bias (RoB/RoB2) assessment was performed for all eight included RCTs (15–21,23). Five of eight studies had high

Table 2. The effectiveness of MT for procedural pain in paediatrics

First author (year)	Subject #	Intervention	Control	Measurement of pain	Statistical test results (P-value)	Study conclusion
Term neonates						
Mirzarahimi (2013)	90	Ipsilateral leg massage (firm but gentle pressure using fingers and thumbs) performed by investigator for 2 min prior to and until completion of heel stick	Standard care in NICU	PIPP, HR, SaO ₂	MT vs. Ctrl: PIPP P=0.02*, HR P=0.10, SaO ₂ P=0.26 MT vs. NNS: PIPP P=0.91, HR P=0.91, SaO ₂ P=0.10	Massage is effective in reducing pain in neonates undergoing heel stick No difference between MT and NNS groups
Mathai (2006)	104	Full body massage (six firm, gentle strokes to each area and continued in cyclical manner) during and up to 2 min after heel stick; not specified who performed MT	Standard care in NICU	DAN score, HR, SaO ₂	MT P>0.05	MT not effective in reducing pain compared to other nonpharmacologic intervention: EBM, sucrose, DW, NNS, rocking NNS and rocking effective in reducing pain at 2- and 4-min post-procedure
Im (2008)	99	Yakson ('healing hand') performed by mothers for 1 min prior to heel stick until completion	Standard care in NICU	NIPS, HR, SaO ₂	MT vs. Ctrl: NIPS P=0.379, SaO ₂ P=0.008*, HR P=0.190 MT vs. NNS: NIPS P=0.926, SaO ₂ P=0.734, HR P=0.770	Yakson massage for heel stick may help neonates maintain SaO ₂ post-procedure No difference between Yakson and NNS groups
Preterm neonates						
Abdallah (2013)	52	10-min whole body moderate pressure massage administered by mothers prior to heel stick	Standard care in NICU	PIPP	P=0.041*	Stable preterm infants benefit from MT administered by their mothers. It is a culturally acceptable alternative method of tactile stimulation
Diego (2009)	56	Trained therapist administered 15-min protocol of moderate pressure massage, with surgical tape removal 15-min post-MT	Standard care in NICU	HR	Mod pressure MT vs. Ctrl: HR following tape removal P=0.019* Mod pressure MT vs. light pressure: Lower max HR P<0.05* Faster HR recovery time P<0.05*	Moderate pressure massage compared to standard care and stimulation placebo attenuates pain response by diminishing HR increase, with a quicker return to baseline

Table 2. Continued

First author (year)	Subject #	Intervention	Control	Measurement of pain	Statistical test results (P-value)	Study conclusion
Jain (2006)	23	Investigators administered 2-min gentle massage of outer aspect of ipsilateral leg (toes to mid-thigh) 5 min prior to heel stick	Standard care in NICU	NIPS, HR, RR, SaO ₂ , cortisol	NIPS P<0.001*, HR P=0.03*, RR P=0.51, SaO ₂ P=0.67, cortisol P=0.62	Lower NIPS and HR (15 bpm increase in ctrl group vs. 5 bpm in MT group), suggesting attenuation of pain response
Term and preterm infants combined						
Zargham-Boroujeni (2017)	75	Light pressure massage performed by researcher for 3 min, followed 2 min later by venipuncture	Standard care in NICU	NIPS	MT vs. Ctrl: P<0.01* MT vs. BF: P<0.01*	Massage reduces pain scores compared to control and BF during venipuncture, and should be considered for pain control as it is an easy, cost-effective intervention
Chik (2016)	80	Trained NICU nurses providing light pressure strokes to both upper limbs for 2 min, 5 min prior to venipuncture	Standard care in NICU	PIPP	P<0.001*	Infants of GA 30 to 40 weeks benefit from limb massage to reduce pain from venipuncture
Burn patients						
Gurol (2010)	63	15-min MT sessions twice per week for 5 weeks, with massage applied by a trained massage therapist to healthy tissue around the wound	Standard care in Burn unit	Visual analog pain scale	P<0.001*	Massage is successful in attenuating pain, in addition to itch and anxiety
Hernandez-Reif (2001)	24	Moderate pressure massage to unaffected body parts, including face, arms, legs, back, and shoulders by a trained massage therapist, 15 min prior to standard dressing care	Standard care in Burn unit	CHEOPS	MT increases torso movements P<0.05; Ctrl increases facial grimacing P<0.01*, torso movement P<0.01*, crying P<0.05*, leg movement P<0.01*, reaching P<0.05* Nurses report less difficulty completing procedure P<0.05*	Children who received MT showed minimal distress behaviours, and nurses reported greater ease in completing the procedure, suggesting that MT helps facilitate dressing changes

Table 2. Continued

First author (year)	Subject #	Intervention	Control	Measurement of pain	Statistical test results (P-value)	Study conclusion
Oncology patients Celebioglu (2015)	25	Licensed massage therapist administered MT for 10–15 min, 20 min prior to IT/BMA, avoiding the injection site	Standard care in Oncology unit	Visual analog pain scale	P<0.05*	MT reduced acute procedural pain and anxiety in children following IT or BMA, compared to standard care

BF Breastfeeding; CHEOPS Children's Hospital of Eastern Ontario pain scale; DAN Douleur aigue du nouveau-ne; EBM Expressed breast milk; HR Heart rate; IT/BMA Intrathecal therapy and bone marrow aspiration; MT Massage therapy; NICU Neonatal intensive care unit; NIPS Neonatal infant pain scale; NNS Non-nutritive sucking; PIPP Premature infant pain profile; RR Respiratory rate; SaO₂ Oxygen saturation.

*Statistically significant.

RoB due to lack of concealment of allocation or lack of blinding of participants/data assessors/investigators (16–19,23).

Manual therapy interventions may be challenging to provide appropriate blinding to participants and personnel. In an attempt to overcome this, we proceeded with a sensitivity analysis for the RoB assessment by removing the performance bias category. Although this improved RoB in four of the eight studies (16–18,23), it still remained high because of failure to achieve all domains. Two RCTs (15,20) had unknown RoB because concealment of allocation was not reported. Only one of the included RCTs was evaluated as having low RoB in all domains (20) (Figure 2). Three studies were CCTs (22,24,25) for which the RoB/RoB2 tool was not used.

We were unable to pool data due to the heterogeneity between the included studies, such as type of massage technique used, patient populations, and pain outcome measures. GRADE was therefore not applied as all included studies were relatively small.

DISCUSSION

There are no previous reviews that used a systematic approach assessing the efficacy of MT for paediatric procedural pain specifically; however, four narrative reviews of MT in general (10,26,27,28) and one narrative review of complementary health approaches for procedural pain (29) have been published. Of all the studies included in these five reviews, two involved paediatric procedural pain and both were included in this present review (15,23).

This current review is the first to systematically address the efficacy of MT and reporting of associated adverse events for mitigating procedural pain in children. We followed the standard methods of data synthesis through searches in five main databases and used duplicate study screening and data compilation.

The majority of clinical trials included showed a positive impact of MT in managing procedural pain. While results in term neonates are mixed, there is supportive evidence for MT in the preterm, burn, and oncology populations.

Limitations

There are limitations of this review. The included studies were heterogeneous in terms of population, massage techniques, and outcome measures, which limits our ability to generalize these results. Field and colleagues have proposed developing a standardized massage protocol that may strengthen the evidence for MT (30,31). Secondly, we did not look for studies that used a similar intervention (e.g., tactile stimulation, touch therapy) unless it was specifically identified as MT (32). Most of the included studies had a high RoB.

Assessment of pain in nonverbal populations can be challenging and may be confounded by hunger, discomfort, temperature, and sleep state. While the pain scores in the included

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias
Chik 2016	+	?	+	+	+	+	+
Diego 2009	+	?	+	+	+	+	+
Hernandez-Reif 2001	+	?	-	+	+	+	+
Im 2008	+	+	-	-	+	+	+
Jain 2006	+	+	+	+	+	+	+
Mathai 2006	+	-	-	-	+	+	+
Mirzarahimi 2013	+	-	-	-	+	+	+
Zargham-Boroujeni 2017	+	-	+	+	+	+	+

Figure 2. Assessment of risk of bias in the studies of massage therapy for paediatric procedural pain*.

*Graph was generated by and adopted from RevMan software by Cochrane Collaboration (Review Manager, Cochrane collaboration).

studies are validated and widely accepted, limitations of physiologic parameters in assessing neonatal pain have been described, including the reflexic nature of these changes, lack of specificity for pain, and variability between individuals (3).

Safety

While the included studies did not report any adverse effects of MT, it is important to consider scenarios where caution must be taken. A systematic review of the safety of paediatric massage identified mild adverse effects, including local pain, swelling, fever, rash (33). Oncology literature recommends caution when platelet counts are low, in febrile states, or near tumour/radiation/mechanical devices (10), and common sense suggests it is reasonable to avoid massage over injured skin or orthopedic injuries. Risks may also be associated with massage by untrained or inexperienced providers (10,15).

Implications

This review demonstrates that MT may be a safe and effective adjunct to conventional care in managing procedural pain in

children. While reported benefits of MT for term neonates are inconsistent, results in the preterm population suggest that MT attenuates pain response compared to standard care alone. In children with burns or cancer, MT may alleviate distress associated with burn treatment procedures and pain associated with IT/BMA, respectively.

CONCLUSIONS

There is preliminary supportive evidence for MT as an effective nonpharmacologic adjunct for management of procedural pain in children. Further clinical trials with rigorous methodology would enhance the quality of evidence.

SUPPLEMENTARY DATA

Supplementary data are available at *Paediatrics & Child Health Online*.

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