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The Role of Osteopathic Manipulative Treatment in Neonatal Abstinence Syndrome

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The Role of Osteopathic Manipulative Treatment in Neonatal Abstinence Syndrome

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Abstract

Context: The United States opioid epidemic has been an ongoing public health crisis. Nationally, maternal opioid use resulted in 82% increase in Neonatal Abstinence Syndrome (NAS), from 2010 to 2017. The opioid withdrawal process of NAS can lead to somatic dysfunctions. Osteopathic Manipulative Treatment (OMT) may decrease muscular and fascial strain in the body and provide relaxation to the NAS neonate.

Objectives: The objectives of this study were to compare the length of hospital stay (LOS) of NAS neonates who received OMT, and neonates given standard medical care without OMT and to evaluate the change in weight of the two groups.

Methods: This was a retrospective cohort study of NAS neonates who received either OMT added to standard medical care or standard medical care alone at Berkshire Medical Center (BMC) in Pittsfield, Massachusetts from January 1, 2013, to December 31, 2018. IRB exemption was obtained. Information was obtained from the electronic medical records. Inclusion criteria were neonates delivered at BMC and diagnosed with NAS. Exclusion criteria were neonates transferred to a tertiary care facility. Data was separated into two groups, OMT and standard medical care only. Records were reviewed for LOS and change in weight. The de-identified data was analyzed and compared via T-tests.

Results: A total of 175 neonates coded for NAS during the study period, with 2 neonates excluded for transfer, leaving 173 (98.86%) neonates meeting the inclusion criteria. Of the 173 neonates 40 (23.12%) received OMT and 133 (76.88%) received standard medical care only. The LOS for all subjects ranged from 2 to 62 days (M=17.06, SD=10.48). In the OMT group, the LOS ranged from 3 to 45 days (M=17.40, SD=14.8). In the standard medical care-only group the LOS ranged from 2 to 62 days (M=16.61, SD=13.1). There was no significant difference in LOS between the OMT and standard medical care-only groups, $t(173) = 0.73$, $p= 0.649$. The change in weight for all subjects ranged from a loss of 15.7 ounces to a gain of 54.1 ounces (M=+7.00, SD=14.12) with an average daily weight gain of 0.4 ounces. In the OMT group the change in weight ranged from a loss of 13.9 ounces to a gain of 51.4 ounces (M=+7.00, SD=11.4) with an average daily weight gain of 0.4 ounces. In the standard medicalcare-only group the change in weight ranged from a loss of 15.7 ounces to a gain of 54.1 ounces (M=+6.40, SD=9.19) with an average daily weight gain of 0.4 ounces. There was no significant difference in weight change between the OMT and standard medical care-only groups, $t(170) = 0.03$, $p= 0.791$. Seven providers provided osteopathic consultation and treatment in the OMT group. We reject our hypotheses that there is an association between LOS or weight change in NAS neonates treated with OMT compared to standard medical care only.

Conclusion: OMT has previously been shown to have similar or beneficial outcomes to standard medical care. In this study, a direct relationship between LOS or change in weight between NAS neonates treated with OMT compared to standard medical care alone was not found. The findings showed similar low and high ranges in the OMT group compared to the standard medical care only group, suggesting that OMT is a safe option for NAS neonates.

Keywords

OMM, OMT, osteopathic medicine, neonatal abstinence syndrome

Conflict of Interest Statement

The Authors Have no Conflict of Interest to Declare

Cover Page Footnote

Aaron Holman-Vittone, MA, epidemiologist, Statistician, performed the statistical analysis. Paul Johansen, MA, Biostatiscian.

ARTICLE

The Role of Osteopathic Manipulative Treatment in Neonatal Abstinence Syndrome

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Key words: OMM, OMT, Osteopathic medicine, Neonatal abstinence syndrome

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1. Introduction

The United States opioid epidemic has been an ongoing nationwide public health crisis. The Center of Disease Control reports changes as three waves beginning in 1999, 2010 and 2013. Overdose deaths initially involved prescription opioids, followed by a rapid increase involving heroin, then illicitly manufactured fentanyl.[1] As of October 16, 2017, the US Government declared the opioid epidemic a public health emergency. This public health crisis has had an associated increase in the rate of maternal opioid use and Neonatal Abstinence Syndrome (NAS). Nationally, maternal opioid use rose from 4.6 to 8.2 per 1000 births, resulting in a 131% increase in opioid-related diagnoses documented at delivery, and 82% increase in neonates diagnosed with NAS, from 2010 to 2017.[2] NAS is a condition which occurs in neonates exposed to opioids in utero, consisting of physiological and emotional symptoms, manifesting 48–72 h after birth. In 2012 the average length of stay (LOS) was 16.9 days compared to 2.1 LOS for a non-NAS newborn.[3] Healthcare Cost and Utilization Project (HCUP) 2020 data found that a newborn with NAS had a nearly five times increased length of hospital stay (15.9-days) compared to a newborn born without NAS.[4]

Common symptoms of NAS are excessive high-pitched crying, increased muscle tone, tremors, decreased sleep, autonomic disturbances (sneezing, increased respirations, sweating), and gastrointestinal symptoms (frequent, loose stools, vomiting, and poor feeding/suckling).[6] Using the neonatal intensive care unit (NICU) Neurobehavioral Network Scale, deficits were found in regulation, quality of movement, and excitability. These neonates were found to have poor Mental Performance Index Scores at 18 and 36 months of age.[7] Long-term outcomes are challenging to assess; complicated by socioeconomic status, caregiving quality, and environmental exposures.[8] NAS outcomes are affected by duration and timing of exposure, the type of exposure (one drug or multiple used), and genetic variations in the opioid receptor/neurotransmitter processing enzymes. NAS neonates are also at higher risk of prematurity and small gestational age.[8,9]

Standard medical care of NAS begins with non-pharmacologic interventions, including reducing stimulation and increasing comfort measures.[10] Rooming-in with parents has been found to decrease the dose and duration of pharmacologic treatment.[11] Breastfeeding is associated with decreased LOS and need for pharmacologic agents, thereby decreasing overall healthcare costs.[12] Since breastfeeding has been associated with more positive NAS outcomes and alleviation of neonate distress, it is important to optimize maternal–fetal contact and assist with breastfeeding techniques as early as possible. Despite these benefits, women with OUD have lower rates of breastfeeding than the general population.[13] When neonatal withdrawal symptoms persist, pharmacologic treatments of morphine, methadone, and buprenorphine are indicated for neonates exhibiting moderate to severe symptoms of NAS to prevent fever, weight loss, and seizures.[10,14] Phenobarbital may be used as a second line agent, particularly in neonates suffering withdrawal from poly-drug exposure.[15] The opioid withdrawal process of NAS can manifest itself in a myriad of somatic dysfunctions. Osteopathic evaluation and the use of Osteopathic Manipulative Treatment (OMT) can assist in alleviating compensatory patterns throughout the muscular and fascial planes of the body and provide relaxation to the NAS neonate.

2. Objective

The primary objective of this study was to compare the (LOS) of NAS neonates who received OMT, and those neonates given standard medical care with no OMT. The secondary objective was to evaluate whether there were differences between these two groups in change in weight during LOS. The results of this study could assist in formulating a protocol for osteopathic care of the NAS neonate. Our hypotheses were that OMT would decrease length of stay and there would be a greater increase in weight for NAS neonates treated with OMT.

3. Method

This was a retrospective cohort study of NAS neonates who received either OMT added to standard medical care or standard medical care alone at Berkshire Medical Center (BMC) in Pittsfield, Massachusetts from January 1, 2013, to December 31, 2018. The standard of care at BMC begins with a nonpharmacologic approach including being held by a caregiver, quiet and low-lit environments, safe swaddling, non-nutritive sucking, clustering care, optimal feed at early cue, safe sleep and fall prevention which all NAS neonates received. If moderate to severe symptoms of NAS present, then pharmacological treatment is implemented. Providers initiate morphine and/or phenobarbital based on severity of symptoms and titrate medication based on response to intervention. There is no

protocol for when to start OMT for NAS neonates, it is dependent upon the pediatric provider requesting an OMT consult. Therefore, there was no consistent time at which an osteopathic consultation was done. IRB (2019-008) exemption for this study was obtained.

Data for this study was obtained from the electronic medical records using the ICD-10 code for NAS (P96.1). Inclusion criteria were neonates delivered at BMC and diagnosed with NAS. Exclusion criteria were neonates transferred to a tertiary care facility. The data was separated into two groups, those neonates who received OMT and those who received standard medical care only. Records were reviewed for LOS, weight at birth and discharge, and OMT providers. Change in weight was calculated using the difference between weight at discharge and birth weight. Then the average change in weight per day was calculated based on the neonates' length of stay. Proposed OMT techniques are described in Appendix A. The deidentified data was stored in a password protected and firewall secure location. Analysis using two-sample T-tests to compare the LOS or change in weight in neonates that received OMT compared to those that received standard medical care only was used. P-value ≤ 0.05 was considered significant.

4. Results

A total of 175 subjects were coded for NAS during the study period with 2 subjects excluded for transfer to a tertiary facility, leaving 173 (98.86%) subjects meeting the inclusion criteria. A two-sample t-test was conducted to determine if the mean LOS was different between OMT and standard medical care neonates (Table 1). Of the 173 subjects 40 (23.12%) received OMT and 133 (76.88%) received standard medical care only. The LOS for all subjects ranged from 2 to 62 days (M = 17.06, SD = 10.48). In the OMT group the LOS ranged from 3 to 45 days (M = 17.40, SD = 14.8). In the standard medical care only group the LOS ranged from 2 to 62 days (M = 16.61, SD = 13.1). There was no significant difference in LOS between the OMT and standard medical care only groups, t (173) = 0.73, p = 0.649 (Fig. 1).

A two-sample t-test was conducted to determine if the mean change in weight was different between OMT and standard medical care neonates (Table 2). The change in weight for all subjects ranged from a loss of 15.7 ounces to a gain of 54.1 ounces (M = +7.00, SD = 14.12) with an average daily weight gain of 0.4 ounces. In the OMT group the change in weight ranged from a loss of 13.9 ounces to a gain of 51.4 ounces (M = +7.00, SD = 11.4) with an average daily weight gain of 0.4 ounces. In the standard medical care only group the change in weight ranged from a loss of 15.7 ounces to a gain of 54.1 ounces (M = +6.40, SD = 9.19) with an average daily weight gain of 0.4 ounces. There was no significant difference in weight change between the OMT and standard medical care only groups, t (170) = 0.03, p = 0.791 (Fig. 2).

Seven providers provided osteopathic consultation and treatment in the OMT group. In the OMT group treatment number ranged from 2 to 26 (M = 9.1, SD = 2.12) treatments per. We reject our hypotheses that there would be an association between LOS or weight change in NAS neonates treated with OMT compared to standard medical care only.

Table 1. Descriptive statistics: Change in weight (ounces).

Table 1

Descriptive Statistics: Change in Weight (ounces)

Received OMT	N	Mean	StDev	SE Mean
No	144	6.4	13.1	1.1
Yes	41	7.0	14.8	2.3

5. Discussion

This study aimed at evaluating the effectiveness of OMT on NAS neonates in decreasing LOS and the influence of OMT on weight change. We hypothesized a decreased LOS and a greater increase in weight in NAS neonates who were treated with OMT. We failed to reject both null hypotheses (p = 0.73; p = 0.97), the findings showed similar ranges and means for LOS and weight changes in both groups. The lack of variance between the groups is suggestive that OMT is safe for NAS neonates.

The relationship between OMT and LOS or change in weight specifically in NAS neonates could not be found in our literature search. We therefore reviewed studies for LOS in neonates who received OMT, irrespective of NAS diagnosis. A 2017 study examining preterm neonates showed a LOS reduction of 2.71 days when they received OMT.[16] Comparing these results to our study, which examined LOS for NAS neonates, including preterm neonates, there was no reduction in LOS for the OMT group (mean 17.38) compared to the standard medical care only group (mean 16.74). A systematic review article of NICU neonates also showed an overall reduction in LOS which was contrary to our

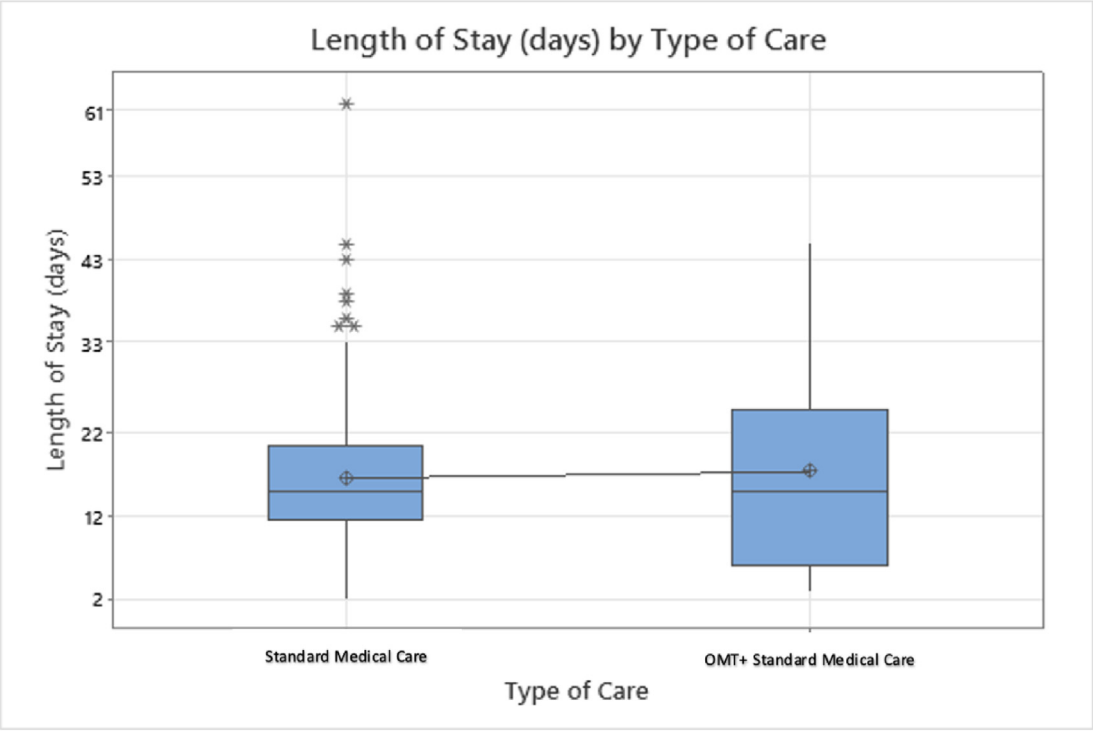

Fig. 1. OMT is referring to osteopathic manipulative treatment in addition to standard medical care. Standard medical care values: mean = 16.61; median = 15; Q1 = 11.5; Q3 = 20.5; IQ Range = 9; whiskers to 2, 23; outliers = 35, 35, 36, 38, 39, 43, 45, 62; N = 145. OMT +standard medical care values: mean = 17.4; median = 15; Q1 = 6; Q3 = 25; IQ Range = 19; whiskers to 3, 45; N = 41.

Table 2. Descriptive statistics: Length of stay.

Table 2
Descriptive Statistics: Length of Stay

Received OMT	N	Mean	StDev	SE Mean
No	145	16.61	9.19	0.76
Yes	41	17.4	11.4	1.8

findings with NAS neonates.[17] Treatment methods were not mentioned in some other studies that examined LOS in NAS neonates. A 2015 study found that NAS neonates had a LOS (mean 16.9 days) similar to the LOS that our study found for NAS neonates (mean 17.06 days) for the combined OMT and standard medical care only groups. A 2019 study also reported similar findings; that neonates with NAS had an average LOS of 15.9 days.[5]

Weight gain in neonates is of importance as is demonstrated in a study conducted by the National Institute of Child Health and Human Development's Neonatal Research Network, which evaluated the association between weight gain in the NICU and long-term neurodevelopmental outcomes in extremely low birth weight infants. Infants in the lowest quartile of in-hospital weight gain (≤12 g/kg/day) were associated with higher odds of cerebral palsy, Bayley scales of Infant Development II mental developmental index <70, and neurodevelopmental impairment at 18−22 months of corrected age, as compared with infants in the highest quartile of in-hospital weight gain (≥21 g/kg/day).[18] Research focused on growth of NAS neonates is inconsistent. Studies have suggested that weight loss in the neonatal period is greater in those with NAS.[19,20] Others have found that neonates compensate for this hypermetabolic state by increased intake and that infants with a diagnosis of NAS grew similarly to controls during their first year of life.[21,22] It has also been proposed that hyperphagia may lead to excessive weight gain.[23] Our study reviewed mean weight change during hospitalization of these NAS neonates, with a mean weight change of +6.86 ounces (0.4 ounces/day) across both OMT and standard medical care only groups. The potential benefits of OMT for neonates should be further clarified.

The design and implementation of randomized controlled trials to show the benefits of OMT is difficult. Standard of care medical therapies that have been demonstrated to be effective cannot be denied; therefore, study design adding OMT to medical therapy which shows similar results across

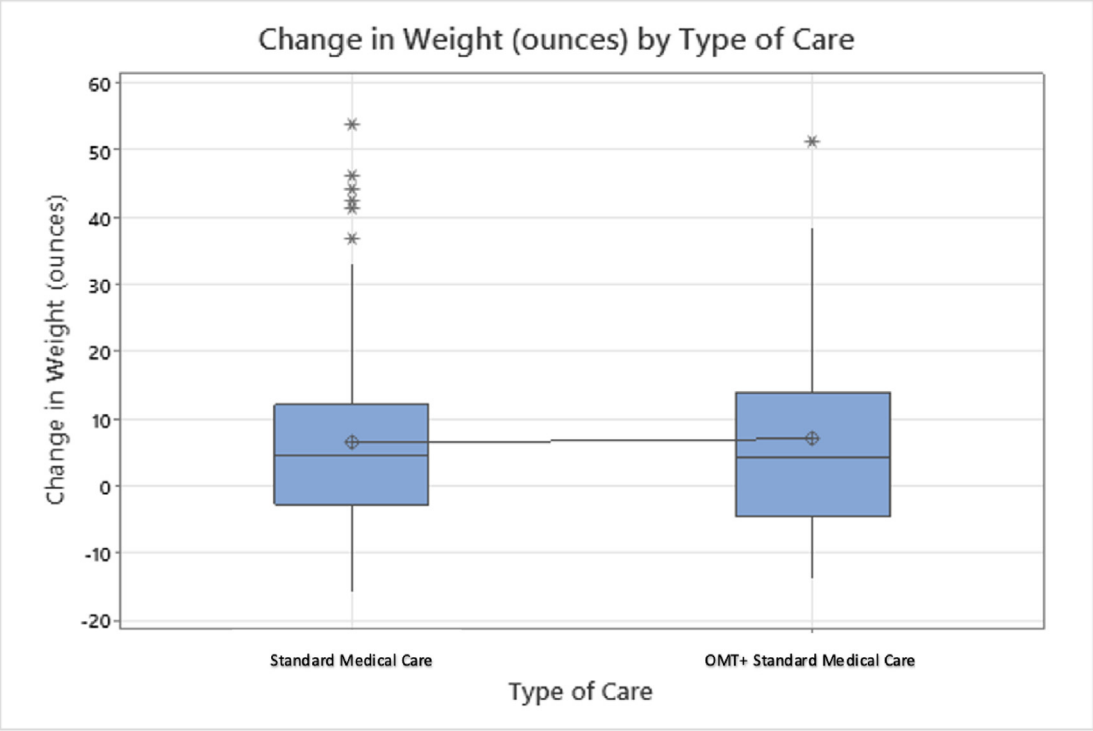

Fig. 2. OMT is referring to osteopathic manipulative treatment in addition to standard medical care. Standard medical care values: mean = 6.4; median = 4.55; Q1 = -2.775; Q3 = 12.075; IQ Range = 14.85; whiskers to -15.7, 33.2; outliers = 36.9, 41.6, 42.5, 44.2, 46.2, 54.1; N = 144. OMT +standard medical care values: mean = 7.0; median = 4.4; Q1 = -4.5; Q3 = 14; IQ Range = 18.5; whiskers to -13.9, 38.6; outlier = 51.4; N = 41.

groups may assist in demonstrating the safety and effectiveness of OMT. Providers varied in the OMT techniques used. Myofascial techniques, balanced ligamentous tension, and balanced membranous tension techniques. There were limitations to this study. An OMT site consult protocol for NAS neonates has not been developed therefore the initiation of OMT was variable among NAS neonates. There is no consistency among pediatricians' request for osteopathic consultation as there is no standard protocol. This study was of retrospective design with inability to form a standardized protocol for giving NAS neonates OMT. Whether OMT was provided, and at what point or for what symptoms a consult was placed, depended on the provider. There was no OMT only group, all NAS neonates who received OMT, did so after starting the standard medical care for the treatment of NAS. Other limitations were the opportunity for error with EMR documentation and retrieval of data. Additionally, our study population was selected from a single institution and geographic region, and we did not account for other health comorbidities, race, or socioeconomic status in our population, thus reducing the ability for generalization. Strengths of this study include that this was a study conducted over a five-year period, it is easily replicable and there were multiple providers performing treatment for standardization.

Future research could include a prospective randomized study, where NAS neonates either receive OMT with standard medical care or standard medical care alone. Alternatively, a retrospective study could include using a larger database with access to long-term follow-up data to clarify whether differences in growth or long-term outcomes exist among subjects. Examining coordination of feeding, rates of constipation and cost of stay in NAS neonates who receive OMT when compared to those who do not could be explored as OMT was shown to be beneficial in a systematic review of NICU neonates.[17] These studies may guide future protocols regarding the use of OMT in NAS neonates.

6. Conclusion

OMT has been previously shown to have similar or beneficial outcomes to standard medical care only. In this study, a direct relationship between LOS or change in weight between NAS neonates treated with OMT compared to standard medical care alone was not found. The findings showed similar low ranges and lower high ranges in the

OMT group compared to the standard medical care only group. The outcomes are suggestive that OMT is a safe option for NAS neonates.

Conflicts of interest

The authors have no conflict of interest to declare.

Appendix A

The following are the OMT techniques proposed in groupings that follow three "systems" used to describe common symptoms of NAS neonates. Within each of these three 'systems', we have also listed the specific NAS physiological symptoms addressed by OMT.

OA/Condylar Decompression.

- Potential associated symptoms: Poor feeding, Uncoordinated suckling, Regurgitation/ Vomiting.
- Goal: Balance tension at Jugular Foramen and Hypoglossal Canal. Directed at CN IX, X and XII to affect latch, suck and swallow reflexes, as well as balancing vagal tone.
- The neonate lies supine, and the physician is seated at the head of the table with both forearms resting on the table, establishing a fulcrum. The physician places the pads of both middle fingers on the posterior aspect of the cranium and slides these fingers down the occiput until the fingers are against the posterior arches of the atlas. The physician applies caudad pressure with both middle fingers to separate the facets from the condylar parts. While the physician maintains this caudad pressure, the patient tucks the chin into the chest, making sure not to flex the neck (this is the nodding movement that occurs at the occipitoatlantal joint). This motion carries the occipital condyles posteriorly, tenses the ligaments in the region, and stretches the contracted muscles in the occipital triangle. The physician maintains this position while the patient holds one or more deep inspirations to their limit. This will enhance articular release. The rate and amplitude of the CRI, as it manifests in the basioccipital region, are retested to assess the effectiveness of the technique. Occipitoatlantal motion testing can also be assessed for normalization[24(p579)].

V Spread for Occipitomastoid Suture.

- Potential associated symptoms: poor feeding, uncoordinated suckling, Regurgitation/Vomiting.
- Goal: Balance tension at Jugular Foramen. Directed at CN IX & X, affecting suck and swallow reflexes, balance vagal tone.
- Neonate lies supine, and the physician is seated at the head of the table with both forearms resting on table, establishing a fulcrum. The physician's thumbs are crossed over the patient's sagittal suture just anterior and superior to lambda. The remainder of the physician's fingers rest on the lateral surfaces of the patient's parietal bones. The physician's crossed thumbs gently exert a force, pushing the patient's parietal bones apart at the sagittal suture. The physician's other fingers encourage external rotation of the parietal bones, decompressing the sagittal suture (this may be accompanied by a sensation of softening and warming or an increase in motion and a physical spreading). The physician moves the thumbs anteriorly approximately 1−2 em, and the procedure is repeated. The physician continues to move along the sagittal suture to the bregma. (This technique may be carried even farther forward along the metopic suture.) The rate and amplitude of the CRI, especially at the sagittal suture, are retested to assess the effectiveness of the technique[24(p582)].

Suboccipital Release.

- Potential associated symptoms: hyperactive reflexes, tremors, hypertonia.
- Goal: Decrease suboccipital muscle tone, improve biomechanical function of head and neck and balance tension at cranial dural connection.
- With the neonate supine, the physician sits at the head of the table with finger pads placed palm up beneath the patient's suboccipital region, in contact with the trapezius and its immediate underlying musculature. The physician slowly and gently applies pressure upward into the tissues for a few seconds and then releases the pressure. This pressure may be reapplied and released slowly and rhythmically until tissue texture changes occur or for 2 min. The pressure may also be continued in a more constant inhibitory style for 30 s to 1 minute[24(p92)].

Balanced Ligamentous Tension to Thoracic Diaphragm[24(p462-466)].

Potential associated symptoms: sweating, hyperthermia, nasal flaring, increased respiratory rate).

- Goal: Optimize respiratory function and restore respiratory-circulatory mechanics.

- The neonate lies supine. The doctor stands at the foot of the table with thumbs at anterior costal margin and the finger pads wrapping around the rib cage to contact the posterior thoracic vertebrae. During quiet respiration, the doctor monitors the lower ribs, thoracolumbar vertebrae and tissue restrictions and then uses contacts to decompress costovertebral articulations and create balanced tension throughout the diaphragmatic dome.

Myofascial Release to the Axial Skeleton[24(p133-149)].

- Potential associated symptoms: hyperactive reflexes, tremors, hypertonia.
- Goal: Improve biomechanical function of the spine and balance the craniosacral dural connection.
- The practitioner is standing, holding the neonate in the supine position. One hand is perpendicular to the neonate's spine, supporting the base of the occiput, cervical and upper thoracic spine. The other hand is supporting the base of the sacrum and lower lumbar spine. The physician gently motion tests the axial spine's indirect barriers in all three ranges of motion: flexion/extension, sidebending, and rotation. Then the physician can gently 'stack' the ranges of motion and wait to allow the axial spine to 'unwind' to a restored sense of balance

Sacral BLT.

- Potential associated symptoms: diarrhea, constipation.
- Goal: Balance tension at the sacral dural connection. Directed at increasing CRI and parasympathetic/vagal tone.
- The neonate lies supine while the physician sits at the side of the patient, placing the caudad hand under the patient's sacrum so that the finger pads are at the sacral base and the heel is toward the sacrococcygeal region. The physician places the cephalad hand across the spine at the level of the dysfunctional segment so that the heel of the hand and finger pads contact the left and right L5 transverse processes. The sacral hand moves the sacrum cephalad and caudad to find a point of ease as the lumbar-contacting hand does the same. The lumbar hand may need to lift upward and downward to balance between flexion and extension. The lumbar-contacting hand then side bends and rotates L5 to the right to find balanced tension in these directions. When this total balanced position is achieved, a slow rhythmic ebb and flow of pressure may present itself at the dysfunctional segment. The physician holds the position against it until a release in the direction of ease occurs[24(p466)].

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