Behavioral and Physiological Effects of Hydrotherapy and Vestibular Interventions for Neonates with Fetal Opioid Exposure: A Case Series on Nonpharmacological Strategies

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Background

Neonatal abstinence syndrome (NAS) refers to withdrawal from fetal exposure to opioids. Incidence of NAS rose 3x in the United States in the last decade (Patrick, 2015). NAS increases hospital length of stay by 20.9 days and costs $1.5 billion annually (Patrick, 2015; Devlin, 2017). Diagnosis is made within the first 24-48 hours, when the neonate displays escalating symptoms across multiple body systems (see chart below). Symptoms are traditionally managed medically by methadone or morphine wean. There is a now a shift towards nonpharmacological symptom management, to decrease length of stay and limit medication exposure, including: Eat, Sleep, Console (ESC) model; environmental modifications; music; massage, breastfeeding; non-nutritive sucking; and vestibular stimulation.

Body System	Symptoms
Central Nervous System	Hyperreflexia, hypertonia, tremors, irritability, tremors, high-pitched cry, disrupted sleep, seizures
Autonomic Nervous System	Temperature instability, yawning, nasal congestion, sweating, mottled skin
Gastrointestinal System	Feeding incoordination, poor weight gain, loose stool, diaper rash, vomiting.

Purpose

1) Compare vestibular stimulation to modified hydrotherapy for hospitalized infants with fetal opioid exposure
2) Analyze behavioral, physiologic, and autonomic responses during baseline, intervention, and recovery phases
3) Expand discussion and range of nonpharmacological interventions available for this patient population

Case Descriptions

All participants were admitted to a level III NICU in Tacoma, WA.

Baby	Birth GA	Tx PMA	Fetal Exposure	NAS Dx	NAS Tx
A	38 6/7	42 4/7	Prescription opioid, SSRI, benzodiazepines	Yes	Morphine Clonidine
B	39 5/7	40 0/7	Prescription opioid	Yes	Morphine
C	34 3/7	37 0/7	Opioids, amphetamines	No	None

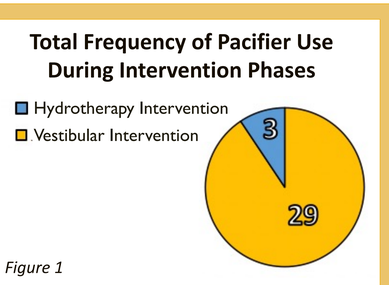


Figure 1

Figure 1: Pacifier required for calming nearly 10x more often during I phase of vestibular intervention compared to hydrotherapy.

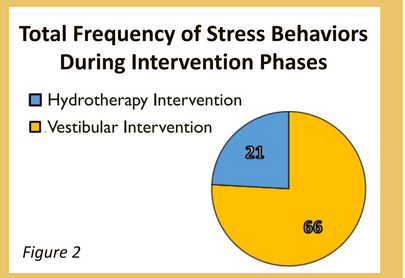


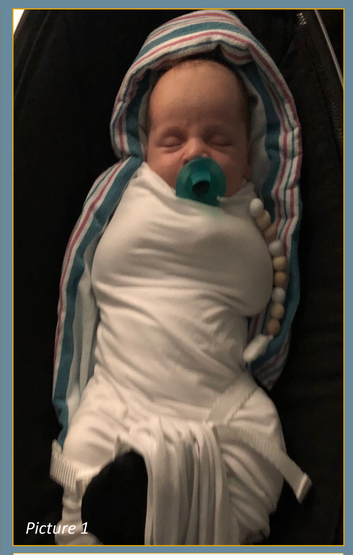
Figure 2

Figure 2: Nearly 3x more stress behaviors during I phase of vestibular intervention compared to hydrotherapy.

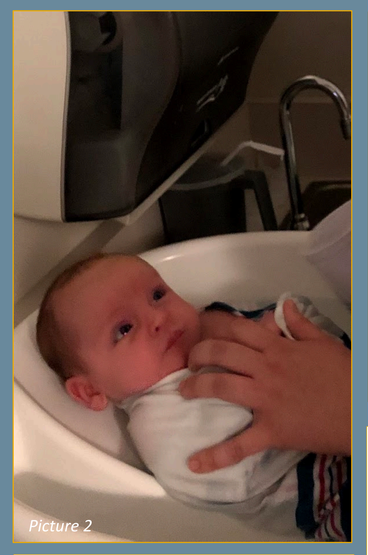
Methods

In additional to standard physical therapy interventions, participants received study interventions, provided in a randomized AB-BA-AB-BA fashion, over 4 days during their hospital stay. Physiologic, behavioral, and autonomic responses were monitored during five-minute baseline (B1), intervention (I) and recovery (B2) phases.

- **Vestibular intervention**: Swaddled rocking in *mamaRoo4 Infant Seat* (4moms), on "Rock-a -bye" setting, at the lowest speed
- **Hydrotherapy intervention**: Swaddled body immersion in 101◦F water using *Turtle Tub* (contoured tub, integrated temperature strip, partial trunk elevation); warm water intermittently poured over chest, arms, and abdomen with swaddle maintained


Picture 1

Picture 1: Set-up for swing intervention with swaddle and rolls.


Picture 2

Picture 2: Participant in behavioral state 4 during hydrotherapy intervention.

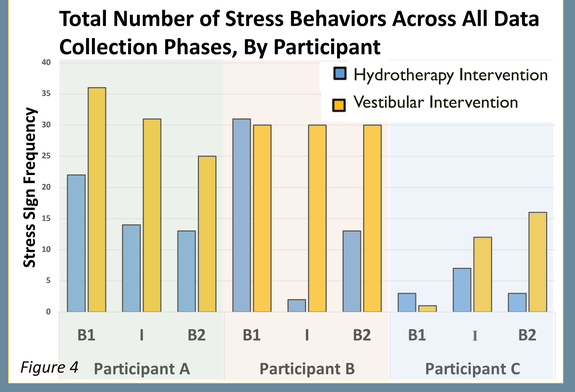


Figure 4

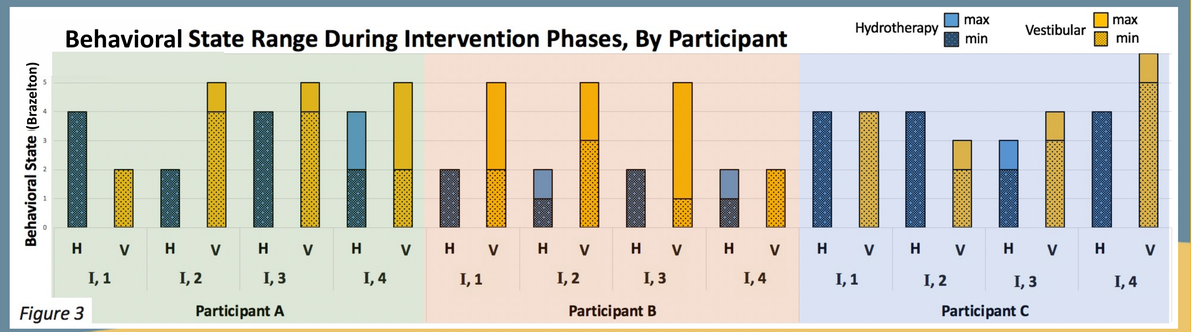


Figure 3

Figure 3: Variability of behavioral state during hydrotherapy and vestibular I phases for each participant during all 4 trials. No change in behavioral state during hydrotherapy 67% of trials, compared to no change during vestibular intervention 14% of trials.

Outcomes

	Hydrotherapy	Vestibular
Physiologic Stability	- No effect	- No effect
Behavioral State Regulation	- Stable I phase - Peak behavioral state = 4 - Calmed crying infant 86% of the time - Calmer behavior overall	- Variable I phase - Peak behavioral state = 6 - Calmed crying infant 14% of the time - Increased arousal overall
Stress Behaviors	- 21 total stress behaviors - Pacifier required 3 times - Participant A and B: less stress behaviors during I than B1 and B2	- 66 total stress behaviors - Pacifier required 66 times - "Cumulative effect" for participant C (more stress signs in I and B2)

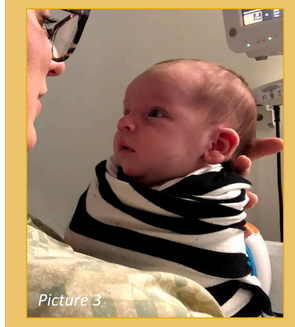
Conclusion

Compared to the standard vestibular intervention, hydrotherapy is an effective alternative nonpharmacological intervention to calm the irritable infant with NAS. Three clinical considerations are:

1) For the preterm infant, continuous vestibular input may overwhelm the sensory system, leading to increased signs of stress.
2) Swaddled water immersion is a safe and effective to calm the irritable infant, reduce signs of stress, and promote behavioral state regulation.
3) Vestibular stimulation may lead to increased arousal and more frequent behavioral stress signs.

The key recommendation for bedside practice is to educate all caregivers on reading infant behavioral cues so individualized interventions may be selected to best promote behavioral state regulation for Infants with NAS. Future areas of research to consider include:

1) Effect of vestibular and hydrotherapy on sleep quality
2) Effect of vestibular and hydrotherapy on meaningful social interaction
3) Caregiver's perception of response to these interventions, and feasibility of incorporating into daily routine.


Picture 3

Picture 3: Visual interaction following B2 hydrotherapy phase.

References

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