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Neonatal Abstinence Syndrome (NAS) and Methamphetamine Use: A Review of Finnegan's as an Assessment Tool in The Women and Newborn Drug and Alcohol Service

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Abstract

Aim: Neonatal Abstinence Syndrome (NAS) is a syndrome that is diagnosed when the infant has been exposed predominately to opioids in pregnancy. Finnegan's is a commonly used tool for health care professionals to assess the neonate for signs of NAS; however, it is not a validated tool for assessment of prenatal Methamphetamine (MA) exposure. There is currently no abstinence scoring tool uniquely for MA exposed neonates. The aim was to investigate the validity of using Finnegan's as an assessment tool for non-opiate drug use and develop an evidence-based tool to assess and manage these high-risk infants in the perinatal period.

Methods: A prospective study was undertaken of 113 infants who were monitored for NAS between July 2015 and 2017. Women had the routine five -day inpatient stay as per current guidelines, and babies were monitored for signs of NAS using the current Finnegan's tool. Data including maternal drug use, smoking, antidepressants, and polysubstance use were collected. Birth details, delivery type, nursery admission, and NAS scores were included and added into the Research Electronic Data Capture (REDCap) [1] database for analysis.

Results: Drug exposure was predominate to Methamphetamine (MA) with 70% of the women reporting heavy use which equated to using more than 10 points (1gram) of MA per week, mostly (79.5%) intravenously. Polysubstance use was reported as 17.9% for greater than 3 illicit substances, smoking rates were high with 87.5% of our women smoking throughout pregnancy. Twenty-six per cent (26%) of infants required resuscitation at birth and 41% of infants required admission to Special Care Nursery (SCN). Prematurity accounted for 24.5% of the sample. The mean NAS score was 2.99. Thirty-one infants (27.7 %) required a longer inpatient stay and 53 infants (47.3%) were slow to feed in the first 48 hours post birth. No infant required medication for NAS.

Conclusions: Finnegan's tool was not a useful tool in this population. We suggest a different model of care is needed for this high-risk group of infants.

Keywords: Methamphetamine use; Neonatal Abstinence syndrome; Non-pharmacological intervention; Pregnancy; Standardised diagnostic tool

Introduction

Neonatal Abstinence Syndrome (NAS) is a generalised disorder presenting a clinical picture of drug withdrawal from opioids in the neonate and has been recognized for more than four decades, [2-4]. NAS describes a constellation of neurological and behavioural symptoms [5-7]. These include Central Nervous System (CNS) hyperirritability (tremors, high pitched cry, irritable, sleep disturbance), autonomic symptoms (sneezing, fever, yawning, sweating, mottling) and gastrointestinal dysfunction (excessive sucking, vomiting, loose/watery stools [8,9] in infants. Most non-opioid fetal drug exposure does not require a Finnegan's scoring system and the infants respond to supportive non-pharmacological measures [6,9].

There are gaps in the research including a lack of clarity and consistency in how the syndrome is measured and managed. Recent studies show that prenatal exposure to nicotine, Benzodiazepines And Serotonin Reuptake Inhibitors (SSRI) may also influence NAS [6,10]. Currently, there are very few guidelines to assist staff with non-opioid withdrawal from MA use, with most of the research focused on the neonate in isolation from the mother, and many hospitals lack guidelines to manage and treat for MA and or maternal polysubstance use. WANDAS has clear guidelines to manage opioid withdrawal within our centre therefore the focus was to develop guidelines to manage non-opioid withdrawal.

The Women and Newborn Drug and Alcohol Service (WANDAS) monitors all infants in the first five days post birth, using Finnegan's assessment tool, for signs of NAS. This tool is not relevant in the current environment where the main drug used by pregnant women in Western Australia is MA and other non-opioid drugs [5,9,10]. Methamphetamine use has been the primary drug of choice for women attending the service for the past ten years. The exact statistics regarding NAS and substance use during pregnancy are difficult to determine due to underreporting of maternal drug use, especially in the context of pregnancy. As the incidence of non-opioid and or polysubstance drug use increases, it is critical to employ a common, objective and validated assessment tools to diagnose, manage and treat symptoms of non-opioid withdrawal symptoms. Commonly used tools include the Finnegan Neonatal Abstinence Severity score, the Lipsitz [3] tool, the Neonatal Narcotic Withdrawal index [11] and the Neonatal Withdrawal inventory [12]. These tools or scores are usually used to assess an infant during a wakeful period before a feed, have up to 12 scores per day.

The aim of this study was to investigate the validity of Finnegan's like an assessment tool for non-opiate drug use and develop an evidence-based tool to assess and manage these high-risk infants in the postnatal period following prenatal exposure to MA. Finnegan's tool is for opioid assessment and unsuitable for MA assessment (Appendix 1 New WANDAS flowchart).

Methods

A prospective study was undertaken in the only Drug and Alcohol Service managing high-risk pregnancies complicated by drug use in a Perth, Western Australia tertiary hospital. WANDAS offers multidisciplinary care to women with drug and alcohol issues in pregnancy. The service is midwifery-led and has medical, obstetric, neonatology, addiction, counselling social work, psychiatric and parent education as part of the team providing wrap around care for women. Maternal drug use is self-reported using a standardised assessment tool for drug and alcohol use [13-15]. Maternal methamphetamine use was classified into mild, moderate (0.5 gram) or heavy use(1gram or above) and assessed by points of MA (1 pt = 0.1 gram or 100 mgs) use during pregnancy. Women have no urine drug screening at the service.

One hundred and fifteen women were recruited to the study. Three women withdrew and their data were not included. To be included in the study women had to report using MA plus or minus other non-opioid drugs during pregnancy. Our service has very clear guidelines to manage withdrawal in opioid dependence and the numbers have reduced and we have had an escalation of MA use in Perth. Exclusion criteria were: intellectual disability, significant mental health issues affecting competence, and current treatment with Methadone or Buprenorphine (Subutex) for opiate dependence. Infants were excluded if they had a significant congenital abnormality. Participants were identified and consented in the antenatal period.

All infants under WANDAS care are routinely observed on the postnatal ward for five days and assessed for NAS using Finnegan's scoring tool. Paediatric review occurs daily and infants are admitted to Special Care Nursery (SCN) if NAS scores are 8 or above on three occasions or a score of 12 on two occasions. Those who require pharmacotherapy are admitted to SCN. Ethics approval was granted by Western Australia's Women and Newborn Health Service Human Research Ethics Committee, the Western Australian Aboriginal Health Ethics Committee, Western Australia's Department for Child Protection and Family Support (CPFS) and the University of Western Australia Human Research Ethics committee. Data were obtained throughout each trimester of pregnancy, and once birthed all data on birth weight, birth mode, Apgar score, NAS outcome scores, head circumference, feeding resuscitation, admission to SCN, feeding method on discharge were entered into REDCap database for analysis [1].

Data Analysis

Maternal methamphetamine use was classified and

documented for each trimester of pregnancy. Descriptive statistics and frequencies were used to describe the characteristics of the sample and analyse the data. Means and standard deviations were calculated for continuous variables and frequencies and percentages for categorical variables. NAS scores, gestational age, birth weight, Apgar scores and polydrug use. Other factors such as smoking during pregnancy, alcohol use, ethnicity and Child Protection and Family Support (CPFS) involvement were assessed and analysed using SPSS statistical software (version 22.0, IBM SPSS Statistics for Windows, Armonk, NY: IBM Corp).

Results

Detailed maternal characteristics are shown in (Table 1). The women gave birth to 113 infants. There was one multiple pregnancies (dichorionic twins). There were two fetal deaths in utero, and one neonate stillborn at 21 weeks following chorioamnionitis. One neonate died at 6 weeks of age, with his death attributed to Sudden Infant Death Syndrome. Maternal MA use was greater in the first trimester with 70% reporting using 15 points (1.5grams) or more per week and 79.5% reported injecting and had binge episodes throughout pregnancy. Polysubstance use was measured by taking more than three illicit substances and accounted for 17.9% of the women. Ninety-two women (82.1%) reported taking 2 or less illicit substance mainly cannabis and benzodiazepine. Smoking rates among our cohort was high with 87.5% or 98 out of 112 smoked throughout pregnancy.

Maternal Demographics	M	SD
Maternal age	29.6	5.5
Ethnicity		
Aboriginal	59	52.7
Caucasian	50	44.6
Other	3	2.7
Marital status		
Single	57	50.9
De Facto	38	33.9
Married	3	2.7
Separated	14	12.5
Education[a]		
Year 10 or above	102	91.1
Year 12	7	6.3
Higher education	1	0.9
Employment[b]		
Employed	8	7.1
Unemployed	100	89.3
Accomodation		
Rented	42	37.5
Living with family/friends	28	25
Owned	2	1.8
Refuge	14	12.5
Homeless	13	11.6
Prison	13	11.6
Delivery Method[c]		
SVD	64	57.1
C/S in labour	20	17.9
C/S no labour	20	17.9
IRSAD[d]	979.2	72.1
Social Advantage and Disadvantage Index	992.2	76.6
Child Protection[e]		
CPFS involved	60	53.6
Apprehension Child Removal	33	29.5
Discharged with parent	18	16.1
Smoking during pregnancy		
Yes	98	87.5
No	14	12.5
Alcohol intake[f]		
2-3 times per week	10	8.9
4+ times per week	4	3.6
2-4 times per month	3	2.7
Monthly or less	17	15.2
Never	76	67.9
Methamphetamine use		
Mild 0.5 gram	28	25
Moderate 1 gram	57	50.9
Heavy greater than 1 gram daily	27	24.1
Polysubstance		

Yes	48	42.9
No	64	57.1
Mental Health		
Effect on mental or psychological health	24	21.4
Diagnosed with Depression	52	46.4
Anxiety issues or problems	23	20.5
PTSD	22	19.6
Bipolar	6	5.4
Other (Childhood sexual Abuse)	33	29.5
[a]The numbers add up to 110 because two were not stated. [b]The numbers add up to 108 because four were not stated. [c]The numbers add up to 109 due to two fetal deaths in utero and one still birth. [d]The numbers add up to109 because four were not stated. [e]The numbers add up to 111 because one was not stated. [f]The numbers add up to 110 because two were not stated.		

Table 1: Maternal Demographics.

Neonatal Data reported in (Table 2). Of the 112 infants, 43 of them (40.6%) were admitted to our SCN immediately post birth of which 66.7% required CPAP. Neonatal complications of methamphetamine and polysubstance use in our cohort included prematurity (25%). Low Apgar scores with a mean of 7.5 at 1 minute and 8 at 10 minutes. NAS scores were normally distributed and were summarised as mean and Standard Deviation (SD), 93.8% of the infants had a NAS score of less than 8, and 6.3% had NAS scores greater than 8 on two consecutive occasions, but did not require admission to SCN for treatment (Figure 2). Accelerated weight loss and poor feeding accounted for 37.5% of the cohort (Table 3). Complications of MA use for our cohort was weight loss due to the infants being sleepy post delivery lasting up to 48 hours post birth which impacted on their feeding. Over a quarter 25.7% of our infants had poor sucking reflex which made feeding difficult. Thirty-one (27.7 %) of the infants had an increased length of stay greater than five days and feeding plans were instigated (Figure 1). Feeding methods were mixed with 30.4% of women breastfeeding, 34.8% of infants formula fed and 27.7% had a combination of breast and bottle. The women were encouraged to breastfeed their infant in the SCN unit or provide expressed breast milk if unable to feed.

Number N = 112	**Number (%)/Mean Standard Deviation**
Sex	
Male	61 (54.0%)
Female	52 (46.0%)
Gestation	37+6 weeks (1.7)
Term	83 (85.5%)
Preterm	27 (24.5%)
Apgar Scores	
1 Minute	8 (2)
10 Minutes	9 (1)
Birth Growth Parameter Centile	
Weight	29th
Head Circumference	31.5th
Length	29th
Birth Weight	
Small for Gestational Age	26 (23.6%)
Appropriate for Gestational Age	77 (70%)
Large for Gestational Age	7 (6.4%)
Special Care Nursery Admission	
Yes	43 (41.0%)
No	62 (59.0%)
Mean NAS Score	2.99 SD 2.084
Department of Child Protection and Family Support (CPFS)	
No Involvement	18 (16.5%)
Involved with CPFS but Child under Maternal Care	58 (53.2%)
Child Removed under a Section 37 Order and placed into Out of Home Care	33 (30.3%)
Footnote :SD Except for Growth parameter , where median is given	

Table 2: Neonatal Data.

Total	Missing	Unique	Min	Max	Mean	StDev	Percentile						
							0.05	0.1	0.25	0.5 Median	0.75	0.9	0.95
111	2 (1.8%)	10	0	9	2.93	2.06	0	1	1.5	3	4	6	8

Figure 2: NAS Scores Post Prenatal Exposure to Methamphetamine Min 0, Max 9.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bottle	39	34.8	34.8	34.8
	Breast	34	30.4	30.4	65.2
	Breast & Bottle	31	27.7	27.7	92.9
	Fetal Death	3	2.7	2.7	95.5
	Not stated	5	4.5	4.5	100
	Total	112	100	100	

Table 3: Feeding Method.

Has the baby increased stay length due to weight loss?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	70	62.5	62.5	65.2
	Yes	31	27.7	27.7	100
	Died	3	2.7	2.7	2.7
	Not stated	8	7.1	7.1	72.3
	Total	112	100	100	

Figure 1: Increased Length of Stay.

Our cohort has a high involvement with Child Protection Services (CPFS) with 60 (53.6 %) of parents having CPFS involved because of AOD use and previous children removed for child safety. Aboriginal families were more likely to have CPFS involvement and 33 (29.5 %) of infants were removed from parental care at five days postnatal age compared to non-Aboriginal families.

Discussion

Our prospective study is the first within our service to monitor NAS in MA cohort. Currently, no prospective studies of withdrawal in methamphetamine-exposed infants are available. A retrospective study by [16] reported withdrawal symptoms in 49% of their sample of 294 methamphetamine-exposed newborn infants. One study suggested up to 49% of MA exposed infants had withdrawal symptoms as recorded on a Finnegan scoring chart yet only 4% were treated for drug withdrawal, but it was not possible to exclude other drugs as contributory in all cases [3,17]. The Ideal study found that MA use during each trimester may be neurotoxic to the developing fetus with prenatal exposure associated with aggressive behaviour, [18] lower IQ and delay in mathematics and language skills [17]. Caution is required when compared to Finnegan scoring as the relatively low rate of severe withdrawal symptoms noted may not indicate protection of the developing human fetus from the potential neurotoxicity of MA [18,19].

Our results highlight that a substantial number (93.8 %) of newborns experienced low NAS scores with prenatal exposure to MA and therefore required an alternative treatment plan. Despite not requiring admission to the SCN unit for NAS, it was common for these infants to need admission for other reasons such as preterm birth, ventilation support and feeding. We found no cardiac or other abnormalities related to MA use in our cohort. Almost a third had a hospital length of stay which exceeded the standard five days' admission. The NAS scoring on the 112 infants in our cohort resulted in a mean NAS score of 2.99 using the current Finnegan's tool and no infant required pharmacotherapy for NAS symptoms (Figure 1). An abstinence syndrome after intrauterine exposure to Central Nervous System (CNS) stimulants such as MA has not been clearly defined [20].

In our cohort, 55% of the women in our women were on SSRI for treatment of depression which also contributes to early signs of withdrawal but not NAS [21]. There has also been an association

between maternal (SSRI) use and NAS, which can be difficult to assess due to the complication of serotonin toxicity [2,22]. The infants exposed to MA and polysubstance use in our cohort required admission to SCN for complications of respiratory distress, prematurity and nutritional issues as opposed to infants exposed to polysubstance use reflects the unstable pattern of maternal use and often the chaotic lifestyle, requiring SCN admission for low birth weights, poor Apgar scores and safety concerns and not for reasons of NAS. Studies have not been successful in predicting which infants require admission to SCN for -non-opioid exposure in the immediate postnatal period [21,23,24].

The major challenge for WANDAS is the lack of a validated abstinence scoring tool for infants who have had prenatal exposure to MA, given that MA use and IVDU was high within our study group and cannabis, benzodiazepine, SSRI, prescription medications, nicotine and alcohol contributed to the polysubstance component. The primary concern for our team regarding the management of the infant is to promote normal growth and development and to minimize poor outcomes. There are no clear guidelines for clinicians in WANDAS for -non-opioid withdrawal and non-pharmacologic care guidelines are lacking. One reason is the lack of large, high-quality, randomized, controlled trials evaluating non-pharmacologic treatment of the neonatal abstinence syndrome [25,26]. Finnegan's tools have remained the gold standard in research [27] but are unsuitable for clinician assessment for infants exposed to non-opioids [10,27,28].

Studies have not be successful in predicting which infants require admission to SCN for non opioid exposure in the immediate postnatal period [21,23,24], however maternal polydrug use in our group may predict the infants at risk, largely due to increased maternal chaotic lifestyles, making presentations at antenatal clinic later, and in some cases no antenatal care where the women are at high risk of co-morbid health issues, placing the infant at risk of admission to SCN. The infants in our study showed signs of withdrawal from nicotine in the first 48 hours in the postnatal period especially with heavy maternal smoking (87.5%) of the women reported smoking and smoked more than 20 cigarettes per day.

The WANDAS model provides for a single room for their five-day hospital stay, promoting rest, bonding and minimal handling of the infant consistent with other studies [29,30]. Ideally, care should be multidisciplinary, collaborative, nonjudgmental, and based on the needs of the mother and baby. The best outcome for infants is to have -non-pharmacological management but a longer inpatient stay where rooming in with the mother, breastfeeding and early bonding is encouraged [21,31]. The infants in our cohort with inadequate weight gain are managed on the postnatal ward where increased frequency of feedings with high-calorie formula or expressed breast milk is encouraged to mitigate some of the effects of maternal drug exposure and NAS. Following discharge, they are followed up for three months postnatally and are discharged to primary care for ongoing follow up.

Limitations

Our study is limited due to the maternal self-report of drug use and no urine drug screening. The rationale for this is access to and engagement in antenatal care is imperative and every effort to assist the women to attend without fear of urine drug screening. Our data are from the only tertiary specialist drug and alcohol service. There was no control group as WANDAS is the only state-wide drug and alcohol service in WA making it difficult to include a meaningful control group.

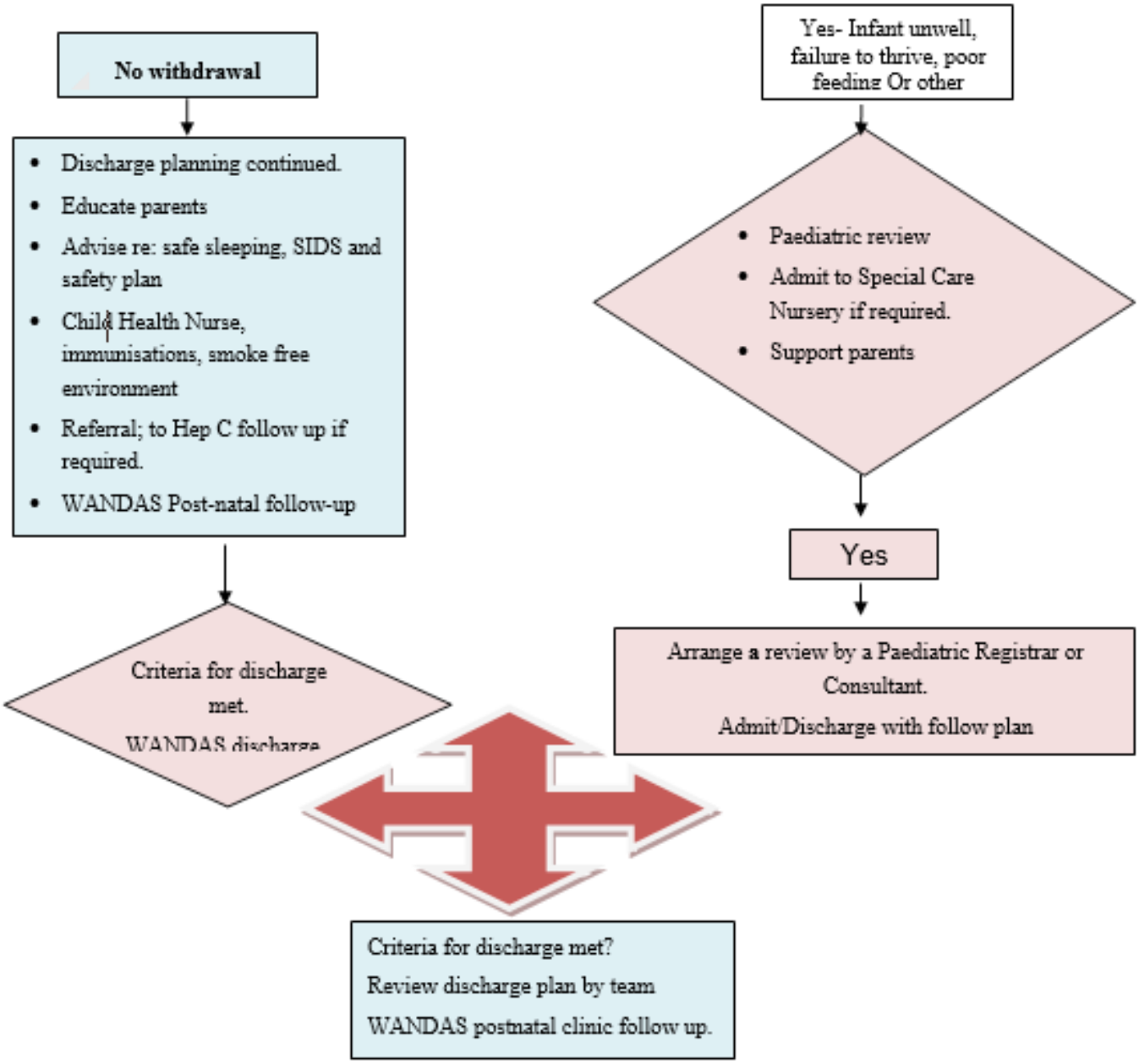
Conclusion

The initial development of NAS scoring systems in the 1970s was a crucial turning point in the care of infants exposed to opioids. However, in WA there has been a decline in opioid use and an uptake of MA use with no guidelines to manage withdrawal. WANDAS proposed guideline will change how clinicians assess the MA exposed infant without Finnegan's. The number of infants exposed to MA in utero and developing NAS has dramatically decreased in the last 10 years in WA. Finnegan's assessment has no value in assessing a group of infants exposed to methamphetamine and other non-opioid drugs suggesting another model of care would be appropriate for monitoring the initial neonatal progress of this group of high-risk infants.

Conflict of Interest

The authors perceive no conflict of interest. There was no funding received for this study.

Appendix 1 and 2



Appendix 1: WANDAS: Management of Infant at risk of Non-Opiate Abstinence Syndrome (NAS) New Flowchart proposed.

Finnegan's Assessment Scoring

NEONATAL ABSTINENCE SCORING SYSTEM

SYSTEM	SIGNS AND SYMPTOMS	SCORE	AM						PM						COMMENTS
CENTRAL NERVOUS SYSTEM DISTURBANCES	Continuous High Pitched (or other) Cry	2													Daily Weight:
	Continuous High Pitched (or other) Cry	3													
	Sleeps <1 Hour After Feeding	3													
	Sleeps <2 Hours After Feeding	2													
	Sleeps <3 Hours After Feeding	1													
	Hyperactive Moro Reflex	2													
	Markedly Hyperactive Moro Reflex	3													
	Mild Tremors Disturbed	1													
	Moderate-Severe Tremors Disturbed	2													
	Mild Tremors Undisturbed	3													
	Moderate-Severe Tremors Undisturbed	4													
	Increased Muscle Tone	2													
	Excoriation (Specific Area)	1													
	Myoclonic Jerks	3													
	Generalized Convulsions	5													
METABOLIC/VASOMOTOR/RESPIRATORY DISTURBANCES	Sweating	1													
	Fever 100.4°-101°F (38°-38.3°C)	1													
	Fever > 101°F (38.3°C)	2													
	Frequent Yawning (>3-4 times/interval)	1													
	Mottling	1													
	Nasal Stuffiness	1													
	Sneezing (>3-4 times/interval)	1													
	Nasal Flaring	2													
	Respiratory Rate >60/min	1													
	Respiratory Rate > 60/min with Retractions	2													
GASTRO-INTESTIONAL DISTURBANCES	Excessive Sucking	1													
	Poor Feeding	2													
	Regurgitation	2													
	Projectile Vomiting	3													
	Loose Stools	2													
	Watery Stools	3													
	TOTAL SCORE														
	INITIALS OF SCORER														

Appendix 2: Finnegan's Assessment.

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