



Cerebral Palsy

Follow Up Of High Risk Neonates

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Survival rates for VLBW Infants <1000 grams

Years	Survival %	Mortality %
1960	10	90
1970	20	80
1980	52	48
1990	70	30
2000	84	16
2004 (Emanuel)	87	13

Factors affecting prevalence rates

- Good prenatal and perinatal care for high risk pregnancy (Early fetal monitoring did not decrease incidence of CP)
- Hospital deliveries
- Use of MgSO₄
- Recognizing and treating maternal infections
- C. Section for breech
- Use of steroids
- RH immunization
- Large population of immunized mothers

Incidence of Cerebral Palsy

- 1965 6/1000 live births
- 1978 3/1000 live births
- 1990 1.5/1000 live births
- 2002 1.2/1000 live births
- 2004 Incidence in VLBW infants <1000 grams 1990-2003 in Neonatal High Risk Follow up clinic is 1.3/1000 live births

Incidence of Cerebral Palsy

50,000 children born/yr with birth weight 1500 gm
 87-90 % survive
 10-15 % have CP

In USA 500,000 individuals with CP (UCP 2004)

Risk of Cerebral Palsy by Birth Weight

B.Wt	>4000 gm	3.1%
B.Wt	<1500 gm	28.1%



Risk of Cerebral Palsy by Maternal Age

25-34 years	.92/1000
>40 years	3.3/1000
<20 years	1.7/1000

Why have Follow Up Programs for High Risk Neonates

- Monitor quality of care -----(Research)
- Monitor for disabling conditions
- Monitor trends in outcomes
- Provide developmental evaluations
- Provide early intervention services
- Support primary care physicians
- Coordinate services with community based programs

Legacy Emanuel Children's Hospital NICU

Level 3 nursery
Involved with the National Vermont Oxford Study OT and/or PT trained in Developmental Therapy for High Risk Newborns evaluate all babies before discharge Referral made to NICU Follow Up Clinic Criteria for referral to the NICU Follow Up Clinic

Nursery Protocol

- Hearing Screen in the nursery
- Eye exams
- Cranial Ultra Sounds
- Dietician
- Neuro-developmental therapy
- Referred for Primary care through pediatrician
- Referral to subspecialty as needed
- Referred to Community Health Nurse
- Referred to NICU F/U clinic

Criteria for Referral

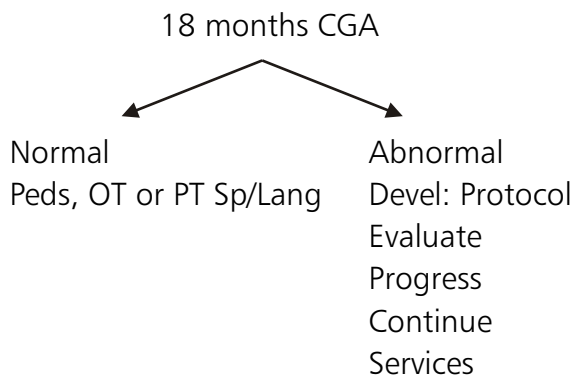
- All infants below 1250 grams
- Intra cranial hemorrhage
- Prolonged apnea/Chronic lung disease
- Meningitis/encephalitis/sepsis
- Intrauterine viral infections
- Intrauterine drug exposure
- Seizures with or without CNS problems
- Genetic/Chromosomal disorders
- Birth defects
- Metabolic conditions
- Perinatal asphyxia at any gestational age
- ECMO babies



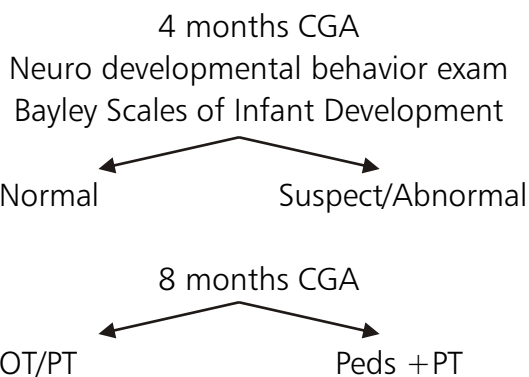
NICU Follow Up Protocol

- Nurse coordinator contacts family 2 months after baby's discharge
- Documents weight gain, growth, feeding, sleep, follow up visits for eye exams , hearing, or other consultants
- Records parent concerns
- If indicated appointments scheduled early

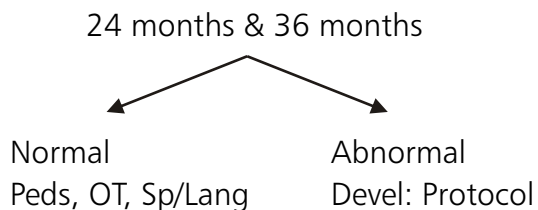
NICU F/U Protocol



NICU Follow up Protocol

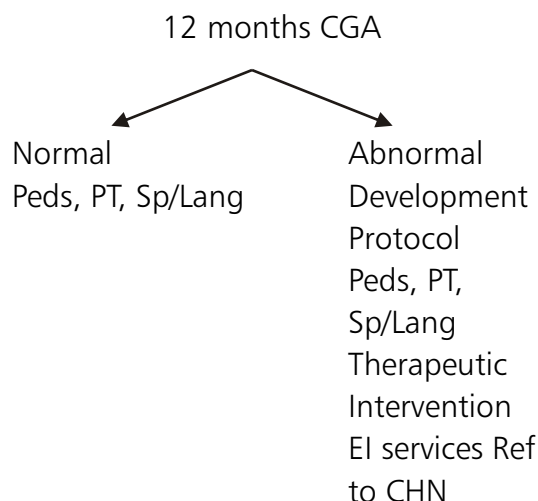


NICU F/U Protocol



5, 7 years includes OT, Psych, Sp/Lang, Pediatrics Focus of evaluation on KG and grade I readiness skills attention and behavior.

NICU Follow up Protocol



Neuro-developmental & Behavioral Outcomes in NICU Survivors

Major disabilities

Cerebral palsy	10-20%
Mental retardation	4-10%
Visual impairment	20-25%
Hearing impairment	5-9%
Associated medical complications	????



Neuro-developmental & Behavior Outcomes in NICU Survivors

Minor Neurological Dysfunctions

- New morbidity
- Increasingly identified with age
- Range from 15-25%

Minor Neurological Dysfunctions in NICU Survivors

- | | |
|-------------------------------------|--------|
| Cognitive deficits | 13-29% |
| • Perceptual deficits | 15% |
| • Speech and language disorders | 12% |
| • Motor in-coordination | 12-15% |
| • Visual motor integration problems | 21.4% |

Neuro-behavioral Outcome in NICU Survivors

- Poor sensory orientation and responses
- Poor regulation of sleep and behavior
- Poor autonomic regulation
- Delayed maturation of visual and auditory responses
- Hypersensitive to external stimuli
- Poor academic performance
- Increased risk for attentional problems

Early Symptoms of CP

- High risk history
- Irritability/ fussy
- Tremors
- Feeding difficulties
- Low sensory threshold
- Increased extensor tone or floppy
- Asymmetrical function
- Decreased volitional movement
- Delayed motor development

Diagnosis of Cerebral Palsy

- There is a high index of suspicion based on the mother's and /or the child's medical history
- Children continue to have persistent primitive reflexes that interfere with movement
- There is a delay or lack of emergence of normal balance reactions that are necessary for head and trunk control
- Lab studies are helpful but not diagnostic.

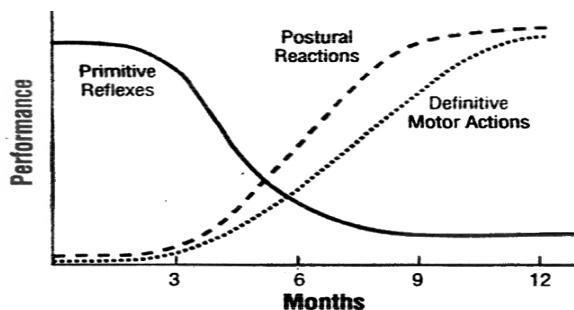


How is the diagnosis made?

- Majority of children with Cerebral Palsy have motor delays
- There is abnormal muscle tone
- Patterns of movement are abnormal
- Children show abnormal posturing of their extremities when they reach and grasp for objects; when they roll, crawl, sit, pull to stand or walk.
- Usually asymmetry of function is noted.

Postural Reactions

- Head righting
- Truncal righting
- Forward protective
- Lateral protective
- Backward protective
- Landau
- Parachute



The declining intensity of primitive reflexes and the increasing role of postural reactions represent at least permissive, and possibly necessary, conditions for the development of definitive motor actions.

From: Capute A.J. et al. *Primitive Reflex Profile*. Baltimore: University Park Press; 1978.

Medical Evaluations

- Screen for ophthalmic problems
- Screen for auditory impairment
- Evaluations by speech language therapists, occupational and physical therapists,
- Evaluation by clinical neuro-psychologists
- Educational evaluation by either a psychologist or special educator

Primitive Reflexes

- Rooting
- Sucking
- Moro
- Palmar
- Atonic neck reflex
- Symmetric tonic reflex
- Galant
- Stepping
- Placing
- Positive Support
- Plantar

Medical Investigations

- No specific tests
- Clinical history, high risk factors and family history important
- History of neurological deterioration
- Most important investigation is an MRI study (include MRI of spinal cord if indicated)



Common Types of CP In Infants < 1500 gm

- Diplegia 57%
- Quadriplegia 22%
- Hemiplegia 11%
- Mixed 10%

Changing Pattern of Major Disabilities in <1000 grams

	1983-1989 N=36	1990-1995 N=77	1999-2002 N=116
CP	12%	14%	13.8%
MR	17%	18%	19.7%
Vision	50%	29%	24%
Hearing	2.7%	1.2%	3.4%

Changing Pattern of Outcomes <1000 grams NICU Follow up clinic

1983-1989	1990-1995	1999-2002
Number referred 55	Number referred 109	Number referred 172
Number seen 36	Number seen 77	Number seen 116

Maternal Medical Conditions

- Lupus, Graves, Hypothyroidism
- Strept: B, Hepatitis C, Chlamydia, CMV, PID
- Sickle Cell Trait, Thalassemia Trait, Anemia
- Renal stones, Hydronephrosis, Nephritis, renal agenesis
- HELLP (hemolytic anemia, elevated liver enzymes, low platelets) 10% with eclampsia develop this syndrome
- Pre-eclampsia with seizures

Reasons for loss to Follow up

- Insurance
- Moved away
- Deceased after discharge
- Larger attrition after 3 years of age for those doing well by parental/ pediatric report

Maternal Medical Conditions

- MS, Migraines, Depression, Bi-Polar disorder
- Myotonic Dystrophy
- Family history of muscle disease
- Uncontrolled Diabetes,
- Cancer breast with Chemotherapy
- Use of steroids, anticonvulsants, alcohol and drugs



Medical Problems in Infants

- Medical Problems in Infants
- Hypotonia
- Hypertonia
- Persistent Hyperbilirubinemia
- Torch and bacterial infections
- Musculoskeletal abnormalities
- Congenital anomalies including cardiac defects
- Hypothyroidism

Possible Etiology for SGA Fetal Factors

- CMV
- Twin to twin transfusion
- Congenital anomalies
- Chromosomal disorders
- Factors affecting outcome
- UV lights for Hyper-bilirubinemia
- Prophylaxis for B-streptococcal infections
- Use of surfactant
- High frequency ventilation
- Developmental therapy
- Prenatal diagnosis of congenital anomalies and treatment

Possible Etiology for SGA Maternal Factors

- Chronic abruption
- Alcohol, cocaine, methamphetamines
- Smoking/Marijuana
- Maternal hypertension and Eclampsia
- Maternal Thyroid disease
- Lupus
- Breast cancer/chemotherapy
- Maternal Cardiac disease
- Poor prenatal care

Message

- A larger proportion of SGA infants had developmental problems.
- Could this be explained on maternal and/or fetal factors?
- 18.7 % mothers were single
- Impact of SES not measured in outcome
- Majority of infants were physically healthy.



Message

- Attrition rate among children doing well is high
- Infants who scored normal on Bayley scales did not always have normal outcomes for language and fine motor adaptive development as pre-schoolers
- Seizures were frequent in infants with perinatal asphyxia
- Incidence of CP remains about the same at EHC since 1995 but lower than the national average.