Approach to a Floppy Infant

INTRODUCTION

"Floppy infant" connotes neuromuscular weakness, though central nervous system or non-neurologic problems must also be considered. This syndrome typically presents with decreased movement, abnormal posture due to weakness, or CNS dysfunction.

Typical signs of hypotonia include: (1) frog-like position, (2) scarf sign, (3) heel to ear test, (4) head-lag, (5) slip thru shoulder sign and (6) inverted U signs.

PATHOPHYSIOLOGY

Two major categories of hypotonia are:

- Hypotonia without significant weakness (nonparalytic) – central hypotonia
- Hypotonia with significant weakness (paralytic) – peripheral hypotonia

Pattern of weakness and localization in the floppy infant:

Anatomical region of hypotonia	Corresponding disorders	Pattern of weakness and involvement
Central nervous system	Chromosomal disorders Inborn errors of metabolism Cerebral dysgenesis Cerebral, spinal cord trauma	Central hypotonia Axial hypotonia more prominent Hyperactive reflexes
Motor neuron	SMA	Generalized weakness, often spares the diaphragm, facial muscles, pelvis and sphincters
Nerve	Peripheral neuropathies	Distal muscle groups involved Weakness with wasting
Neuromuscular junction	Myasthenia syndromes Infantile botulism	Bulbar, oculomotor muscles exhibit greater degree of involvement
Muscle	Congenital myopathies Metabolic myopathies CMD Congenital myotonic dystrophy	Weakness is prominent Proximal musculature Hypoactive reflexes Joint contractures

HISTORY

Important factors to obtain in the history include:

- Onset of hypotonia
- Need for ventilatory support (significant muscle weakness)
- CNS abnormalities
    - Consciousness, seizures, apnea, feeding difficulties, abnormal posture, abnormal ocular movements
- Congenital malformations other than CNS
- Craniofacial dysmorphic features
- Prenatal risk factors
    - Drug/teratogen exposure
    - Breech presentation
    - Reduced fetal movement
    - Polyhydramnios
- Perinatal history
    - Birth trauma
    - Birth anoxia
    - Delivery complications
    - Low Apgar scores
    - Delivery
- Past health including drug history
- Family history
    - Parental ages
- Motor milestone achievement

Physical Examination

The physical examination usually indicates whether floppy infant syndrome is due to a neurologic dysfunction, and, if so, whether it is centrally or peripherally based. It should include the following:

- Evaluation of mental status
- Infants with hypotonia secondary to a neuromuscular process often appear very bright and alert despite their weakness.
- Those with CNS dysfunction will likely have cognitive involvement.
- In nonparalytic hypotonia, the infant may initially appear weak and floppy, but spontaneous movements of the limbs occur readily against gravity. Posture and tone should be noted in the supine position, in ventral suspension, and with traction. Look for the presence of a "scarf" sign.

- The presence of brisk tendon reflexes in a hypotonic child almost always signifies that hypotonia is due to cerebral dysfunction. Further development may reveal spastic cerebral palsy.
- Tongue fasciculations are best seen at the lateral margins of the tongue as spontaneous rippling movements with the infant still (not crying). They are most commonly associated with denervation as seen in spinal muscular atrophy.
- Facial weakness (decreased expression) is often seen with congenital myotonic dystrophy, myotubular myopathy, congenital muscular dystrophy, congenital facial diplegia, trauma, or Moebius syndrome.
- Ptosis/ophthalmoplegia suggests myotubular myopathy, mitochondrial myopathy, congenital muscular dystrophy, myasthenia gravis, or congenital fibrosis syndrome.
- Arthrogryposis and contractures are seen in congenital muscular dystrophy, myotonic dystrophy, and neuropathies.
- Hip dislocation should be considered in any hypotonic child. To screen for this, Ortolani maneuver and hip x-ray studies should be done.
- Weakness and respiratory problems are seen in many conditions, such as spinal muscular atrophy, myotonic dystrophy, myotubular myopathy, nemaline myopathy, and congenital muscular dystrophy.
- Swallowing/sucking difficulties can be seen in myotubular myopathy, myotonic dystrophy, nemaline myopathy, and neonatal myasthenia.
- Weakness and loss of tone in the lower extremities with active use of the upper extremities suggests spinal cord injury.

Laboratory Aids

- Cytogenetics and molecular biological tests
    - Karyotype e.g. Down syndrome
    - Subtelomeric FISH
    - Molecular diagnosis e.g. PWS
- Electrophysiological tests
    - EMG (electromyography)
    - NCV (nerve conduction studies)
    - To differentiate nerve (axonal/demyleinating), NMJ and muscle problems
- Studies of muscle pathology
    - Muscle biopsy

    - Immunohistochemistry
    - Electron microscopy for structures of organelles
- Biochemical studies
    - Muscle enzymes
    - Metabolic studies
        - Ammonia (urea cycle defects, organic acidaemias, fatty acid oxidation defects)
        - Lactate (CHO metabolism, mitochondrial disease)
        - Amino acids pattern (aminoacidopthies)
        - Organic acids and acylcarnitine profiles (organic acidaemia and fatty acid oxidation defects)
        - VLCFA (perioxisomal disorders)
        - Uric acid (low in molybdenum co factor deficiency)
        - Isoimmune electrophoresis pattern (disorder of glycosylation)
        - 7-dehydrocholesterol (elevated in Smith-Lemli-Optiz syndrome)
- Neuroimaging studies
    - Structural malformations
    - Neuronal migration disorders e.g. lissencephaly
    - White matter changes e.g. merosin-deficient CHD
    - Basal ganglia e.g. mitochondrial disease
    - Cerebellar and brainstem abnormalities e.g. Joubert syndrome, pontocerebellar hypoplasia

Reference

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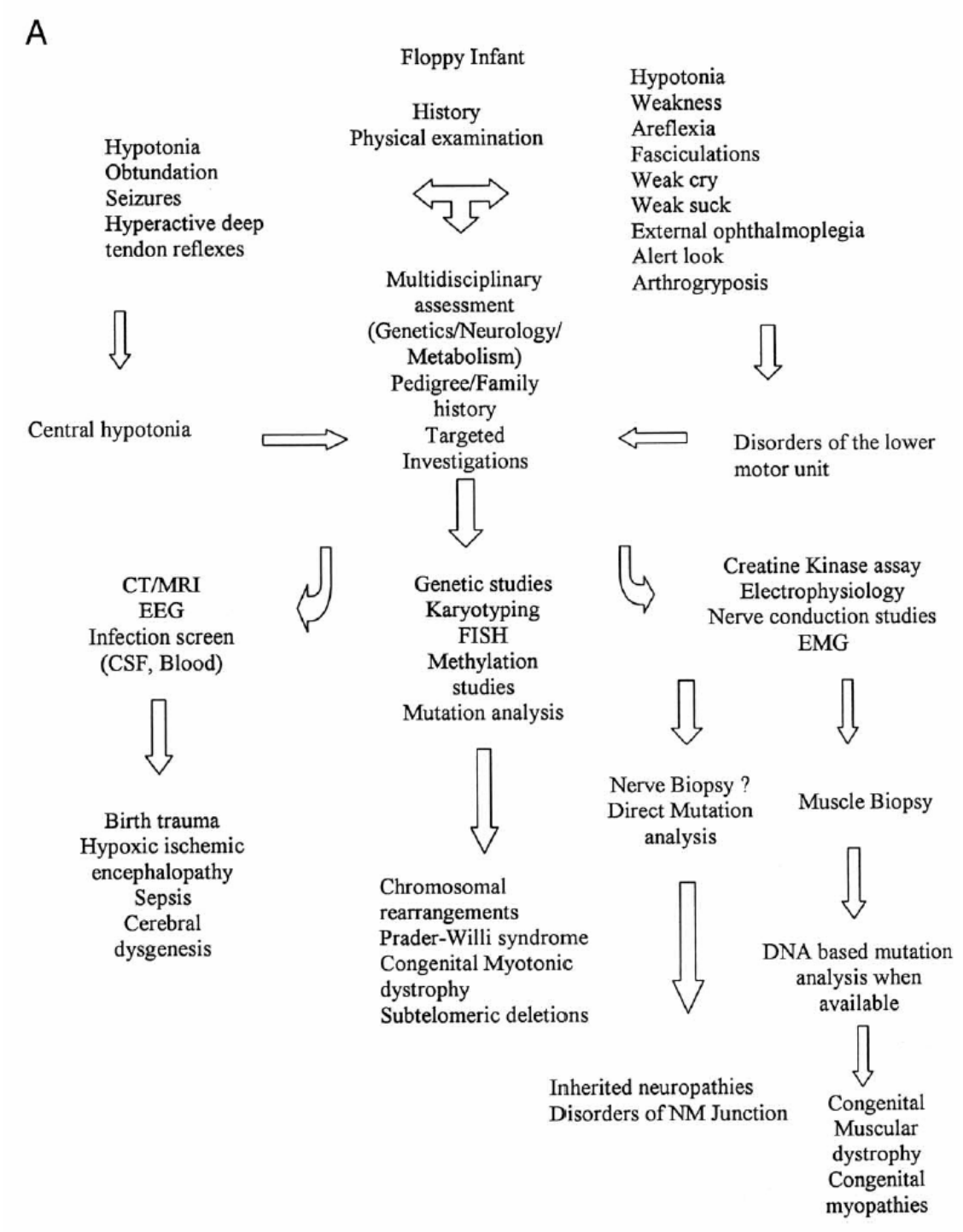
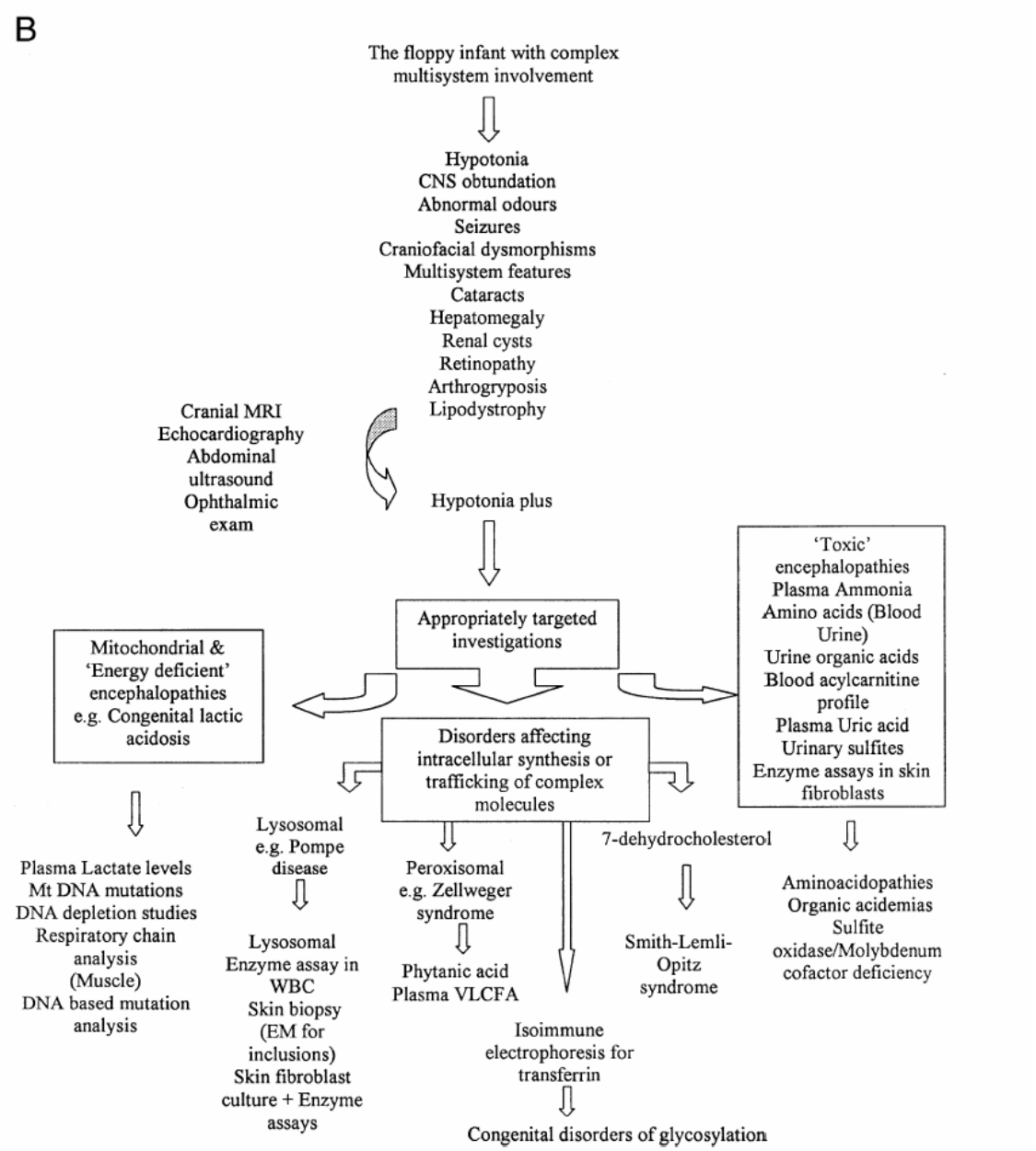


Schematic diagram for evaluation of Floppy infant without multi-system involvement



Schematic diagram for evaluating floppy infant with multisystem involvement