Clinical Evaluation of the Child with Developmental Delay - State of the Art

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Developmental Delay

- Chronic disorders
- Etiologically heterogeneous
- Essential feature a recognized disturbance or delay in one or more developmental domains
- Significant & continuing impact on a child’s developmental/functional progress
- Common pediatric problem affecting 5-10% of the pediatric population
- Recognition based on ongoing process of developmental surveillance and possibly systematic screening
Developmental Delay Subtypes

- Global Developmental Delay*
- Mental Retardation*
- Developmental Language Disorders (Specific Language Impairment)
- Gross Motor Delay
  - +/- Cerebral Palsy
- Autistic Spectrum Disorders
- Primary Sensory Impairments
  - Visual
  - Auditory
- School Related
  - ADHD
  - Learning Disability
Global Developmental Delay

- Significant delay in two or more developmental domains
  - Usually all domains affected
- Significant = performance two or more standard deviations below the mean on age appropriate standardized norm referenced tests
- Term usually applied to children less than 5 years of age
- Later diagnosis of mental retardation frequent
Mental Retardation

- Significant sub-average general intellectual functioning existing concurrently with deficits in adaptive behaviour
- Limitations in at least two areas of adaptive behaviour that reflect the degree to which an individual functions effectively within society
- Systems of support required across the lifespan
  - Individual
  - Educational
  - Vocational
  - Recreational
- IQ scores < 70 (IQ normally distributed-mean =100, SD=15)-used to stratify severity of delay
- Term usually applied to children older than 5
Global Developmental Delay & Mental Retardation

- Related, complementary, non-synonymous terms
- Chronologically framed by what can be reliably observed and measured
  - Many children with GDD will later be diagnosed as MR
  - Many children with MR originally diagnosed as GDD
- Diagnostic labels
  - Clinically recognizable entities
  - Mandates a particular evaluation, management & intervention approach
- Children typically evaluated at less than 5 years of age when GDD diagnosis more appropriate
Evaluation of Childhood Developmental Delay

- **Aims & Objectives**
  1. Confirm the existence of a delay
  2. Categorize and classify precisely the developmental delay
  3. Search for a possible underlying responsible etiology*
  4. Referral to appropriate rehabilitation services
  5. Inform & counsel family
  6. Manage associated medical/behavioural conditions
     - Spasticity, epilepsy, inattention, feeding, sleep disturbances
     - Aggression, stereotypies, obsessions, opposition
     - Actualization of full developmental potential
Developmental Delay - Etiologic Determination

- Etiology = “specific diagnosis that can be translated into useful clinical information for the family, including providing information about prognosis, recurrence risks and preferred modes of available therapy”
- Usually a question asked and answered only by detailed assessment
Developmental Delay - Etiologic Determination

- Importance
  - Recurrence risks estimation
  - Prevention
  - Specific therapy
  - Modify management (associated conditions, programmatic approach)
  - Prognostication
  - Family empowerment
  - Limitation of further unnecessary testing
Elements of Evaluation

- History
- Physical Examination
  - General
  - Neurological
  - Developmental
- Laboratory Investigation
- Referral
  - Consultations
  - Rehabilitation services
History

- **Comprehensive Family History**
  - Developmental, health, school attainment status of siblings, parents and other relatives
  - Significant neurological impairments
    - CP/GDD/ASD/MR/DLI
    - Epilepsy (convulsive disorders)
    - Mental illness
    - Neuromuscular disorders
  - Parental consanguinity
  - Ethnicity
History

- Mother’s pregnancy/prenatal care
  - PV bleeding
  - Gestational diabetes
  - Premature labour
  - Medical conditions/medications
  - Toxin exposure - alcohol, illicit drugs
  - Intrauterine infections
  - IUGR/Antenatal anomalies
  - Foreign birth
History

- Labour/Delivery
  - Timing
    - Premature/Term
  - Mode
    - Vaginal/Forceps/C-S (indication)
    - Vertex/Breech presentation
  - Meconium /FHR changes/APGAR scores (1 & 5 minutes & beyond)
  - Birthweight

- Neonatal
  - Encephalopathy
    - Invariably occurs if intra-partum difficulties are of neurologic relevance
  - Seizures
  - Feeding difficulties
  - Associated conditions
History

• Medical
  – Chronic conditions, hospital admissions, surgery, medications, vaccination status

• Social
  – SES, marital/custodial status, child care arrangements

• Special services
  – Rehabilitation
  – Social supports

• Family Centered Care
  – What are the family’s major challenges?
  – What should “we” focus on to provide greatest benefit?
History

• Developmental
  – Age of initial concern
  – Domain(s) of concern
  – Progression in each domain
  – Current capability in each domain
  – Activities of daily living
  – Play skills
  – Any loss or regression of skills?
    – Possibility of a neurodegenerative condition
Physical Examination

- Fluid & adaptable
- Maintain child’s proximity to caregiver
- Tell child what to expect even if non-verbal
- Leave intrusive (ie hands-on) aspects to end
- General-special emphasis on:
  - Height/Weight
  - Dysmorphic features (look at parents!)
  - Hepatosplenomegaly
  - Cutaneous markers of phakomatosis
  - Spine
Physical Examination

• Neurological
  – Head circumference-OFC
    – Percentile
    – Measure parents if <3rd or > 98th
  – Visual/auditory apparatus integrity
  – Bulbar findings
  – Motor
    – Focal findings
    – Dyskinesias
    – Dexterity/co-ordination/planning
    – Strength (Gower sign/up & down stairs)
  – Gait-walking & running
  – Balance
Physical Examination

• Developmental
  – In the preschool child developmental assessment is the bulk of the neurologic examination
  – Non-invasive & non-intrusive
  – Observational, detached, non-threatening
  – Appropriate playthings
    – Blocks, crayon & paper, balls, simple puzzles, stuffed animals/dolls etc
  – Supplemented by formal developmental assessment
    – Office based
    – OT/PT/SLP/Psychology assessments
Physical Examination

• Developmental
  – Fine Motor
    – Blocks
    – Pencil/Paper skills-scribbling, copying
    – Eating skills (report)
  – Gross Motor
    – Rolling, sitting, crawling, standing, cruising, walking (gait), running
    – Ball playing
    – Stairs
    – Tricycle, bicycle (report)
Physical Examination

• **Language**
  - Identification of body parts, pictures, colours, shapes
  - Spontaneous/story telling
  - Plurals, pronouns, sentence structure
  - Following commands

• **Cognition**
  - Puzzles, concepts (numbers, big/small, on/under, long/short, open/close)
  - Analogies
  - Categories
Physical Examination

• **Activities of Daily Living**
  - Feeding
  - Dressing
  - Toileting
  - Sleep

• **Social**
  - **Play** - Key discriminator between GDD/DLI/ASD sub-types
    - Self
    - Other children
  - **Interaction**
    - Parents
    - Examiner
History & Physical Examination: What We Should Know

1. Static vs Progressive encephalopathy
2. Sub-type of developmental delay
   - Frames etiologic assessment & rehabilitation referrals
3. Current developmental level (functional skills)
4. Possible suspected underlying etiology
   - Directs targeted evaluation
5. Suspected timing (prenatal vs perinatal vs postnatal)
6. Current rehabilitation and social service provision
   - Identification of needs
Laboratory Investigation

- Selective and rational
- Determined by history & physical examination & sub-type of developmental delay
- Not determined by severity of delay
- Controversy regarding extent
- Recent advances
  - Genetics
  - Molecular biology
  - Neuroimaging
Laboratory Investigation

- **CK** (muscle weakness)
- **Toxins**
  - Thyroid (absent neonatal screening)
  - Lead (psychosocial impoverishment/CDC guidelines)
- **Metabolic Screening**
  - CBG/lactate/pyruvate/ammonia/LFTs/amino acids/organic acids/VLCFA/carnitine
  - Absent neonatal screening, consanguinity, episodic decompensation, prior affected child, multiple non-ectodermal organs affected, imaging changes
- **Radiologic**
  - Bone age (macrosomia)
  - Skeletal survey (dysmorphology/storage)
Laboratory Investigation

- Genetic
  - Karyotype (high resolution)
  - FISH specific syndromes (e.g. PWS/Angelman 15q-)
  - Sub-telomeric probes
  - Array Comparative Genomic Hybridization
  - Molecular (e.g. Fragile X-Triplet repeat expansion FMR1, Rett syndrome-MECP2)
  - Specific enzymatic analysis
Laboratory Investigation

• Electrophysiologic
  – EEG-if paroxysmal events
  – EMG/NCS-if peripheral involvement suggested
  – Evoked Potentials-if hearing or vision suspect

• Neuroimaging
  – CT
  – MRI
    – Newer techniques-not yet generally recommended
      – Volumetric
      – DWI
      – fMRI
      – MRS
Referral

• Consultations
  – Genetics-syndromic diagnosis, testing
  – Ophthalmology-visual integrity
  – Audiology-hearing screen
  – Psychiatry-behavioural issues
  – Nursing-specific care needs, feeding, family support
  – Social services-financial, respite

• Rehabilitation Services/Community Resources
  – Occupational therapy-fine motor, ADL, feeding
  – Physiotherapy-gross motor
  – Speech-language pathology-language
  – Psychology-cognition, behaviour
Recommended Testing

- **American Academy of Neurology/Child Neurology Society**
  - Practice Parameters
    - Guidelines for diagnostic evaluations based on available evidence
    - Best practice given a particular situation
      - Global Developmental Delay
      - Cerebral Palsy
      - Autism
    - Algorithms developed yet individual latitude given needs and uniqueness of particular clinical situation
Recommended Testing

- **Global Developmental Delay**
  - **Lead**
    - Targeted to those with identifiable risk factors
  - **Thyroid**
    - Targeted to those without newborn screening or specific systemic features of hypothroidism
  - **Metabolic**
    - Indicated if no newborn universal screening
    - Historical or physical examination findings suggestive of possible metabolic etiology
      - Parental consanguinity
      - Prior loss
      - Episodic decompensation
      - Regression
      - Dysmorphic features/hepatosplenomegaly
Recommended Testing

- **Global Developmental Delay- Parameter Recommendations**
  - **Genetic**
    - Karyotype routinely even if no dysmorphic features
    - FMR1 molecular genotyping
    - FISH if delay unexplained or specific syndrome suggested
  - **EEG**
    - Only if suggestion of seizures or an epilepsy syndrome
  - **Neuroimaging**
    - Routine with MRI preferable to CT especially in the context of physical findings
  - **Hearing/Vision screening**
    - Obligatory
Recommended Testing

- **Global Developmental Delay**
  - Additional considerations
    - Bone age if macrosomic (Soto syndrome)
    - Sub-telomeric probes
    - Array CGH
      - FISH study spanning entire genome
      - 5-10% yield being reported
    - MECP2
      - Severe unexplained delay in both females and males
Global Developmental Delay-Etiology

- **Main etiologic categories**
  - Intrapartum asphyxia (22%)
  - Cerebral dysgenesis (16%)
  - Chromosomal abnormality (13%)
  - Genetic syndromes (10%)
  - Psychosocial deprivation (10%)

- **Top 5 categories account for 80% of etiologic diagnoses made**

- **Others-term PVL, toxins, metabolic, infectious**
Global Developmental Delay - Etiology

• Factors predictive of etiologic yield
  - Female gender (2x greater frequency of yield)
  - Abnormal pre/perinatal history
  - Absence of any autistic features
  - Microcephaly
  - Abnormal neurologic exam
  - Dysmorphic features

• Factors not predictive of etiologic yield
  - Family history of GDD/MR
  - Severity of GDD
  - Co-existing seizure disorder
  - Macrocephaly
Global Developmental Delay
Etiology

- In the absence of any abnormal features on history or physical examination, screening investigations (karyotype, FMR1 molecular genotyping & neuroimaging) revealed an underlying previously unsuspected etiology in an additional one-sixth (16%) of children with a global developmental delay
Global Developmental Delay - Etiology

- **Autistic features negative predictor**
  - Parallels poor etiologic yield in children with diagnosed ASD (PDD & PDD-NOS)

- **Severity of delay not a predictor of etiologic yield**
  - Vigor of etiologic search not predicated on how severely affected the child may be
  - Severity should not be a factor influencing referral for sub-specialist evaluation
Global Developmental Delay - Etiology

- Over a third (42%) of etiologic diagnoses potentially preventable (intrapartum asphyxia, psychosocial deprivation, toxin exposure) at a theoretical level

- A third of etiologic diagnoses have implications regarding recurrence risk estimation and modifications in medical management
Key Points

- Recognition of sub-types of global developmental delay & mental retardation
- Overview of comprehensive neurodevelopmental assessment
- Aspects of specialty evaluation & management
- Importance of etiologic determination
- Targeted evaluation & investigation