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NEUROLOGICAL EXAMINATION IN PEDIATRICS– A REVIEW ARTICLE

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ABSTRACT

A basic neurologic examination in a child can be performed rapidly with practice. Many of us find difficulty in doing soo in pediatric age group. The presence of an abnormal result usually warrants further investigation and referrals to specific specialties. It helps to recognize and therefore manage diseases earlier in their course. A complete neurologic examination should contain an assessment of sensorium, cognition, cranial nerves, motor, sensory, cerebellar, gait, reflexes, meningeal irritation, and long tract signs. Specific scales are useful to improve interobserver variability.

KEYWORDS: Cranial nerve examination, motor and sensory system, gait, tone and power of muscle.

INTRODUCTION

The neurological examination is an assessment tool to determine a paediatrics neurologic function. It is beneficial in a variety of ways as it allows the localization of neurologic diseases and helps in ruling in or ruling out differential diagnoses. Neurological diseases can present a myriad of ways, including cognitive/behavioral, visual, motor, and sensory symptoms. Certain red flags during examination allow early detection of life-threatening neurologic diseases and recognize disorders that may negatively impact the quality of life.[1]

The neurologic examination is useful in both ambulatory and emergency settings. It provides the paediatrician a tool to recognize neurologic involvement in certain disease

states, and thereby allow proper work-up and treatment for these patients. It also beneficial in intensive care units, particularly in monitoring neurologic sequelae of diseases like strokes, intracranial tumors, and traumatic brain injury.[2][3] In emergent settings, rapid assessment of the severity of an injury and neurologic involvement is crucial and leads to fast decision-making in patient management, as well as improvement of patient survival rates.[4]

Paediatric Glasgow Coma Scale[5]

Rapid neurological assessment in children is done by using pediatric Glasgow coma scale. Theis scale is modified in relation to age as adults and children respond differently to various stimuli. Glasgow coma scale in paediatrics is as below given in table.

Score	Infants	Children
Eye opening		
4	Spontaneously	Spontaneously
3	To verebal commond	To speech/verbal stimuli
2	To pain only	To pain only
1	No response	No response

Best motor response

6	Spontaneous and purposeful movements	Obeys commands
5	Withdraws to touch	Localises painful stimulus
4	Withdraws in response to painful stimulus	Withdraws in response to painful stimulus
3	Abnormal flexion response to pain (decorticate posturing)	Abnormal flexion response to pain (decorticate posturing)
2	Abnormal extension response to pain (decerebrate posturing)	Abnormal extension response to pain (decerebrate posturing)
1	No movements after painful stimulus	No movements after painful stimulus

Best verbal response

5	Coos and babbles, smiles and recognises familiar objects and person	Oriented and converses appropriately
4	Uncertain recognition of objects or person and irritable cry	Disoriented and confused
3	Cries in response to pain	Replies inadequetly and speaks incoherently using inappropriate words.
2	Moans in response to pain	Makes only incomprenhensible sounds
1	No response	No response.

Mental and emotional Status[6]

The mental and emotional status of the child depends on various factors, including the health status. For instance, as sick child would not be interested in the surroundings.by observing

the child, the health status may be assessed to some extent .types of emotional and mental status are given as below:-

- Happy, playful, alert and interested in the surroundings.(normal healthy child)
- Anxious (anxiety neurosis)
- Elation: a feeling of well being or excitement (in bipolar mania)
- Euphoria: an exaggerated feeling of well being often not justified by circumstances.
- Depression:-depressive psychiatric disorder
- Restless (hyperactive child and child with pain)
- Dull, not interested in surrounding, apathetic or irritable (in kwashiorkor)
- Shy and timid or obstinate (seen in overprotected child)

Cranial Nerves[7]

Cranial nerves	Examination	Clinical findings
1-olfactory	Test the ability to smell in each nostril separately with closed eyes.	Anosmia- loss of smell Parosmia–perversion of smell, distorted.
2-optic	Gross vision –test if child recognises parents/strangers. Tests wether child smiles at mother or not	Not smiling at mother, blank staring, unresponsive to facial expression, not following light, objects
	Visual acuity-snellen chart, tumbling E chart or Cardiff cards for distance vision. N charts, jagers chart, Cardiff near charts for near vision	Not able to see distance things clearly in short sightedness and near things in long sightedness.
	Visual fields –test by confrontation method and perimetry.	Visual fields defect
	Colour vision –test by ishihara chart and precision vision 16 test	Inability to recognises different colour.
	Examination of fundus by opthalmoscope or slit lamp.	Evidences of papilooedema, chorioretinitis.
3-occulomotor	Observe the eye at rest in primary position of gaze.	Drooping of eyelids(ptosis) dilated pupil, divergent squint
	Ask the child to follow the objects.observe the movements of eyeball in all direction.	Decreased movement of eyeball(except abduction of eye caused by lateral rectus and downward movement of adducted eye by superior oblique)
	Dolls eye movements –turn the head to one side. When the brain stem is intact, the eye ball will move in the direction opposite to the head of the movement.	Presensce of eyeball movements indicates supranuclear lesion or an intact brain stem.
4-Trochlear	Ask the patient to look at the nose (downward movement of the adducted eye)	The child is not able to see downward with adducted eye.

5-Trigeminal	Check the sesations over the face (except for a small area over the angle of jaw)	Abscent sensation
	Ask the child to chew something to check the muscle of mastication	Deviation of jaw on chewing, difficulty in chewing.
6-Abduncent	Ask the patient to look laterally	Not able to see laterally. convergent squint.
7-Facial	Inspection of the face	Obliteration of nasolabial fold. deviation of the anmgle of mouth to the opposite side. droolong of the saliva on the same side.
	Ask the patient to close eyes tightly (orbicularis oculi)	Inability to close the eye tightly.
	Ask the patient to wrinkle the forehead.	Abscence the wrinkle on the forehead on the affected site.
	Ask the patient to blow (buccinators)	Inability to blow the air.
	Ask the patient to whistle(orbicularis oris and buccinators)	Inability to whistle.
	Ask the child to show his teeth.	Deviation of angle of mouth to the opposite side.
	Eversion of the lower lip. (platysma)	Eversion of lower lip is weak or abscent.
8-Vestibulocochlear	Watch test for hearing – place the watch.	Not able to hear tickling of the watch or crumpling of paper near the ear.
	Rinnes test –normally test should be positive, i.e air conduction> bone conduction.	Negative (bone conduction > air conduction)
	Webers test –place the vibrating tunning fork over the glabella. The sound will be perceived equally on both sides in normal children.	Central.(both ears are affected) Lateralized to the affected side(when one ear is affected)
9-Glassopharyngeal	Taste-check for test sensation in posterior one –third of tongue.	Abscent –ageusia
10-vagus	Palatal and pharyngeal sensation –test by touching the palate.	Abscent sensation
11-spinal accessory	Inspect neck muscle Trapezious – ask the child to shrug his shoulder.	Wasting shoulder drooping child not able to shrug affected shoulder.
12-hypoglossal	Observe the tongue at rest and during movement.	Abnormal movements
	Bulk of tongue	Wasting of tongue Small
	Size of tongue Palpate the tongue	Flaccid –LMN palsy Spastic-UMN palsy
	Power – ask the chid to protrude the tongue and look for any deviation.	Tongue deviates to the side of lesion.
	Ask the child to push cheek with tongue.	Child not able to push cheek with tongue.

Motor Exam

The inspection of the muscles is the first step in doing the motor examination. Any visible scars, deformities, fasciculations, and asymmetry (swelling or atrophy) should be noted. This is followed by palpation to assess for mass lesions or tenderness if present.

The range of motion (ROM) is used to assess tone and helps localize injury or disease to the joints or muscles. On doing the passive ROM, the physician check's for flaccidity, spasticity, and rigidity. The active ROM can give a clue to strength and pain-related causes of decreased range. The presence of spasticity or flaccidity can help differentiate an upper motor neuron from a lower motor neuron cause of weakness, while the presence of cogwheel rigidity points to a specific disease like Parkinsonism.[8]

Finally, the assessment of muscle strength is done. The manual muscle testing is scored as follows:

MRC grading of muscle weakness[9]

Grade	Clinical examination
0	Total paralysis
1	Visible or palpable flicker or trace of contraction, not enough to move the joint.
2	Able to move eliminating the gravity
3	Able to move against the gravity but not against resistance.
4	Able to move against partial resistance
5	Normal power

Assessment of muscle strength should occur in an orderly fashion. Testing should be done to differentiate proximal from distal muscle weakness, as well as compare the left and right sides. The location of the weakness concerning other neurologic deficits can help differentiate a cortical lesion (hemiplegia from a stroke), from a brainstem lesion (crossed deficits from an MS plaque), from a spinal cord lesion (presence of dermatomal level), from a peripheral nerve lesion (neuropathy or radiculopathy), and a muscular disease (myasthenia gravis).

Assessment of tone[10]

Clinical examination	Normal	Hypotonia	Hypertonia
Inspection –posture	Normal	Frog position	Stiffness
Palpation of muscle	Normal	Flabby	Rigid
Resistance of passive movements	Normal	Decreased	Increased
Range of passive movements	Normal	Increased	Decreased

Sensory Exam

The sensory exam involves the assessment of patient-reported symptoms that includes a diminished or exaggerated perception of sensation. Modalities tested include pain, temperature, vibration, and position sense. The location and pattern of sensory deficits are also helpful in localization. Pain sensation is assessed by using a sterile pin and test for sharpness or dullness. A tuning fork can be used to evaluate vibration sense. A piece of cotton can serve to assess for light touch, while the assessment for position sense can be done by testing the distal phalanx and asking the patient the position of the digit with eyes closed. An abnormal sensation can involve the sensory cortex, the thalamus, the brainstem, the spinal cord, and the peripheral nerves. Cortical lesions present with diminished sensation on the contralateral side, spinal cord lesions present as a sensory level, radiculopathies involve a specific dermatome, and neuropathies can have a glove and stocking distribution.[11]

Gait

The assessment of a patient's gait can be as simple as watching the patient walk into the room. It is essential to keep in mind that gait changes can be brought about by several factors, including weakness, neuropathies, arthritic changes, excess weight, and pain. A specific gait disorder that is recognized can point to a particular disease process or neurologic involvement.

Assessment of the gait involves observing the stance, the stride, the balance, and the heel strike. Balance and strength could have further evaluation by asking the patient to walk on their tiptoes or heels and walking in tandem (the heel of the front foot touching the toe of the back foot in a straight line). Recognition of an extensive list of different gaits linked to various pathologies is crucial in the early detection of neurological diseases.[12] Assessment other gait also allows an understanding of a patient's level of functioning.

The child is asked to walk briskly for a distance of about 10 m, then turned to 1800 and return back. The child is also ask to walk with heel to toe in straight line. The length and the width of of steps is noted.

Some common abnormal gait recognized include[12]

- Antalgic gait - altered gait due to pain, such as "limping."
- Paretic gait - due to partial paralysis/weakness (e.g., steppage gait)
- Spastic gait - due to stiffness of the limbs

- Ataxic gait - broad-based and uncoordinated gait, might be due to cerebellar or sensory involvement.
- Hypokinetic - shuffling and slow gait, might be due to basal ganglia involvement.
- Dyskinetic - disturbance due to involuntary movements like dystonia or athetosis
- Equinus gait[13] – seen in any condition with shortening of Achillis tendon. it is seen in spastic cerebral palsy.
- Scissoring gait[14] –seen in patient with infantile diplegia, it is due to adductor spasm.
- Magnetic gait[15] – seen in myotonia and frontal lobe tumour.
- Shuffling gait[16] – seen in spasticity.

Deep Tendon Reflexes[17]

Reflex	Spinal segment	Response
Bicep reflex	C5,C6	Flexion at the joint with visible contraction of biceps muscle.
Supinator reflex	C5,C6	Contraction of brachioradialis with flexion of elbow.
Triceps reflex	C6,C7,C8	Extension of elbow with visible contraction of tricep muscle.
Knee jerk	L2,L3,L4	Extension of knee due to quadriceps contraction.
Ankle jerk	S1,S2	Planter flexion of the ankle with visible contraction of calf muscle.

Superficial reflexes[18]

Reflex	Centre	Normal respon
Abdominal reflex	Spinal segments T6-T12	Muscle of abdomen contracts
Cremasteric reflex	L1-L2	Testicle is pulled up .
Planter reflex	L5,S1	Flexion of great toe.
Scapular reflex	C5-T1	Contraction of scapular muscle
Anal reflex	S3,S4	Contraction of external anal spincter
Bulbocavernous reflex	S3,S4	Contraction of Bulbocavernous.

Meningeal Signs

The presence of meningeal signs reflects an irritation of the meninges. Maneuvers include assessment of nuchal rigidity by passive flexion of the patient's neck, and the presence of pain and resistance indicates a positive result. Other maneuvers include the Kernig sign, where a passive extension of the knee while the leg is flexed at the hip in a supine patient causes pain, and the Brudzinki sign, where passive neck flexion causes reflex knee flexion in the supine position.[19] Usual causes of meningeal irritation include CNS infections and subarachnoid hemorrhage.

It is crucial to remember that when examining a patient, a focused physical and neurologic exam is complementary to a detailed history and is key in achieving proper diagnoses.[20]

Nursing, Allied Health, and Interprofessional Team Interventions

Although a full neurological examination with its specific maneuvers and domains is within the comfort zone of neurologists, it is an essential tool in the arsenal of primary care physicians. Neurological examination is somewhat difficult in children due to stranger anxiety but can be performed easily with good skill hands. Localizing a disease to the neuroaxis will assist them in the appropriate management and referral to appropriate specialties. Also, basic neurologic assessment should be a point of emphasis for other health care professionals, especially in areas with a high likelihood of seeing neurologic cases such as in emergency rooms, intensive care units, and post-operative monitoring.[21]

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