PAEDIATRIC PAIN RELIEF

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Nothing begins nothing ends that is notpaid with moan for we are born in other's pain& perish in our own

— Francis. T

Children, the unique miniature human forms, though loved and cared most, do suffer in pain when hurt — as intensly as adults, neverthless more intensly than adults!

The importance of study of pain in paediatrics should be considered not only from its clinical & therapeutic angle but also should be thought as a blue-print for the coping strategies to pain, devlopment of pain syndromes, acceptance of methods of pain-relief in adulthood, since the emotinal-affective component is processed during one's infancy & childhood. The common & widerspread contention that babies tolerate pain better than adults has been proved wrong, of late. Recent literature regarding pain-pathways in this age-group clearly indicates that the pain-perception is well devloped at birth, even in premature newborns. Any understimation of pain during the perioperative period can exert a stressful experience leading to unpleasant consequences.

Development of pain-perception This can be divided in 2 Groups.

1) In foetus, neonate & infancy Physiologic devlopment of pain-pathways.
2) Ininfancy, early chidhood & adoolescence_Physiologic aspect of pain, the so called emotional-affectivecomponent.

A) PHYSIOLOGICALDEVLOPMENT-

Sixth week of gestation -Devlopment of synapses in the dorsal horn of spinalcord.

Seventh week of gestation-Cutaneous sensory perception appears in the peiroral area & spread to include all the cutaneous as well as mucous membranes.

12th to 14th week of gestation-Substance P & its receptors are detectable in the foetal dorsal horn & c. s. f of term *infants & concentration of B-endorphin* increases in response to stress.

Although the basic somatosensory pathways are present at birth, further devlopment takes place in the neonatal period and thereafter. The CNSis not sufficiently organised enough for predictable behavioural responses. Animal experiments though present are not functonal, cortical immaturity being present.

By the 24-30 week of gestation pain pathways to the brainstem & thala-mus are complete myelinated. Inearly foetal life lack of myelination is compensated by the shorter interneuron distances & neurmuscular distances.

The maximal activity associated with nociceptor impulses is localized in the regions of sensorimotor cortex, thalamus, midbrain-brainstem regions. Stimulation of

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the pain-pathways results in behavioural, physiological, metabolic & hormonal changes consistent with pain. Nociception is indicated with signs of distress such as facial grimace, rise of pulse rate & B.P., palmarsweating a fall in transcutaneous 02 tension. Such changes have been observed in neonates undergoing circumcision and heel pricks. These changes can be attenuated by adequate analgesia. Hormonal changes like increases in plasma concentrations of catecholamines, glucagon, cortisol aldosterone and decrease in insulin. This hormonal stress responses can be reduced by provision of effective analgesia.

As mentioned already the lack of descending inhibitory pathwaysresults in experiencing pain in the newbornmuch more in intensity & duration of the pain is prolonged. Though the pain felt is profound, the reactions are diffuse.

B) Development of affective component : - At birth pain perception is present as a unpleasant sensation. Its interpretation as an emotional experience devlops during infancy and childhood. This partly also depends upon the surroundings factors such as upbringing, family background, social & cultural influences. Sensitivity to pain is greater in younger age groups than older age groups, the pain-threshold being lower in younger children of 5years of age than children of 11-18 years. It is the lack of communication and inability to interprete pain in younger children underestimates the severity of their pain.

PAIN ASSESSMENT IN CHILDREN
Is based on broadly 2 methods.

1) Subjective methods : Pertain to self-reported pain and self-assessment of pain, these are superior to objective methods but are not suitable to children below 3-4 years of age as cognitive skills are not devloped. They are as follows:-

a) Verbal scales — e.g. Mcgill pain questionnaire.
b) Numeric scales - e.g. Visual analogue scale
c) Pictorial scales - Smiley analogue scale.
   i) Scales showing Painful faces.
   ii) Colour of pain
   iii) Drawings of pain

d) Hester's Poker chiptool - Quantificationof pain by seeing it as pieces of hurt that can be graded from 1 to 4.

Subjective methods are suitable for childrenbelow the age of 4 years. Hence objective methods are used to assess pain in this age groups.

2) *Objective methods* : Due to the lack of development of cognitive functions objective methods narrated below are useful.

a) Behavioural methods — Indicate true distress for pain. Simple motor response - Diffuse body movements like flexion and adduction of lower limbs with grimacing and crying.

   Facial expressions - Brows down and together, nasal root broadened and bulged, eyes tightly closed and the mouth angular, squarish, nasolabial furrow present.

   Crying - Pain-cry is differentiated from other types of cries. Begining with deep

inspiration and then an expiratory cry followed by further expiratory cries of varying duration.

Complex Behavioural responses - Prolonged periods of NREM sleep. (non rapid eye movement sleep) Increased periods of wakefulness & irritability. Disorientation, poor motor responses.

b) **Cardiovascular changes :** There is rise in pulse rate, blood-pressure. An altered vagal tone which is a sensitive index for pain in neonates as indicated by decreased amplitude of respiratory sinus arrythimia is taken as a reliable sign. Fluctuations in transcutaneous Po2 levels and palmar sweating are also important parameters.

c) **Metabolic changes :** Increased levels of catecholamines, growth hormone, cortisol, glucagon and aldosterone along with decreased levels of Insulin have been observed. Levels of B-endorphin are increased. These changes result in breakdown of carbohydrate and fat stores leading to hyperglycemia, increased levels of lactate, pyruvate, ketone bodies, glycerol and free fatty acids. Protein breakdown results into increase nitrogen excretion with - ve nitrogen balance and altered amino acids.

MANAGEMENT OF ACUTE PAIN

Types of Acute Pain :

1) Perioperative Pain
2) Bone-marrow aspiration.
3) Biopsies and Short diagnostic procedures.

Relief of Acutepain :

Pacifying a baby by holding, cuddling and caressing who is in distress with pain though sympatheitc and affectionate in addition requires relief of acute pain with drugs, regional analgesic techniques. In recent years improved knowledge towards routes of administration of drugs, their dosage schedules, concept of PCA (Patient controlled analgesia), infusion-pumps and better availability of paediatric regional block equipment has brought analytical outlook towards paediatric analgesia.

While administering analgesia in paediatric patients following points should be always considered.

1) In the liver enzyme-systems concerning glucuronidation, sulfation, oxidation and cytochrome 450 system are not mature enough at birth; Adult levels are reached by 1 month. Paracetamol is well tolerated by neonates. Hepatotoxicity by overdose have alow incidence. Non-steroidal anti-inflammatory drugs (NSAIDS) are quite effective in older children. They should be avoided below the age of one year. It is better to avoid aspirin altogether for its side-effects; Soalso the drug Indomethacin, in particular shouldbe avoided below the age of 1 year and in prematures.
2) Glomerular filtration rate (GFR) is low in newborns. Hence one has to be careful about the dosages and frequency of administration.
3) There is large volume of distribution for water-soluble drugs owing to the

greater area of body water in children. Therefore initially there is lower plasma concentration.

4) Since viscera & brain form the greater proportion of body-weight, any active metabolites enter brain in greater proportions exerting their effect.

5) Plasma proteins, albumin and alpha-glycycoproteins have alower content compared to the adults and older children. Thus greater availability of free portion of unbound is available to produce acute toxicity; For e.g. Bupivacaine.

6) Ventilatory responses to hypoxia and hypercarbia are low in neonates.

7) Elimination ½ life of amide local anaesthetic s is prolonged.

8) Epidural fat being sparse in infants and children, peak levels of local anaesthetic are attained faster.

9) Absorption of local anaesthetic from the mucous membranes, interpleural and intercostal blocks attains blood-levels comparable to I.V. administration.

10) The duration of the local anaesthetic effect is short, though the elimination ½ lives are longer and thus systematic accumulation on repeat-dosage can cause adverse side effects. Hence dosage, frequency of repeat-dosage and infusion rates should be lower compared to adults.

Non-opioids - i.e. NSAIDS (Non Steroidal Anti-in flammatory drugs) are useful for routine use Paracetamol is well tolerate by neonates of infants.

ADMINISTRATION SCHEDULE OF NON-OPIODS

DRUG	Route	Dose	No. of doses/day	Maxm.
Paracetamol	Orally	10-15 mg/Kg	4-6	60 mg
* Ibuprufen	orally	5-10 mg/Kg	3-4	40 mg
* Ketorolac	orally	10 mg/dose	4	40 mg
	I.V./I.M.	1 mg/Kg. loading		
		0.5 mg/supplem.		2 mg/kg
* Indomethacin	orally	1 mg/Kg	3	3mg/Kg

* Avoid below 1 year

Administration of Opioids :

Opiods are suitable above 6 months. The best way to adminstor them is by giving in infusion form Morphine is well suited but side effects such as hypoxaemia, excessive sedaton, nausea, vomiting are possible. Hence nowdays PCA - Patient controlled Analgesia ' is a prefered technique of opiods infusion; but it is suitable for older children. The following schedule for opirids may be considered.

Drug	Rate	Dose
Codeine	Oral use only	1.2 mg/Kg.
Fentanyl	I. V	10.20 mcg/Kg/h. as infusion
Marphine	I. V.	0.5 mg/Kg.
		Dilution - Make up 5 0 ml with - 5% Dextrose. Neonates - 0.5 - 1.5 ml/h Infusion rate 5-15 mcg/Kg/h Older children - 0.5 - 4.0 ml/h Infusion rate - 5 - 40 mcg/Kg/h

It should be remembered that neonates and infants less than 6 months are particularly susceptible to the respiratory depressant effect of opiods as the pharmacokinetics is altered. There is increased permeability to blood-brain-barrier, increase in endogeneous opiods and changes in the number of opiod receptors in this age group. The clearance of morphine is 1/40th of the adults, but the volume of distribution as similar to adults.The elimination ½life of morphine is 5 times larger than that of adults.

Hence it is necessary that direct supervision, good maintaining is essential when intravenous administration of opirids is used.

REGIONAL ANALGESIC TECHNIQUES :

Epidural anasthesia and analgesia via caudal, lumbar and thoracic route with indwelling catheter using local anastheic drugs, opioids in either single dose or infusions has been found to be an effectve method.. However technical expertise and experience is needed for safe usage. Among local anasthetics Bupivacaine is a most suitable agent. For extradural blockade usually 0.25% to 0.125% bupivacaine is used. The initial dosage should not exceed 2 mg to 2.5mg/kg. Further the infusion rate i.e. advocatedis 0.1-0.15ml/kg/hr.

The complications such as convulsions from local anasthetic toxicity rarely occur if one is careful in restricting the bupivacaine dosage to 0.4 to 0.5mg/kg/hour. Some sedation is necessary in case of infants along with these local techniques, hence often opioids are combined with local anasthetics. 0.1% Bupivacaine is combined with 2mcg/ml. of fentanyl and 0.3ml/kg/h, has been reported to have been used successfully. Epidual morphine 30-50mcg/kg with infusion ate 5mcg/kg/h, is also said to be quite effective, but severe pruritus was noticed. Risk of respiratory depression has to be kept in mind. Recently epidural clonidine added to

local anasthetic in epidural and caudal blocks (3mcg/kg-5mcg/kg) has been found to produce enhanced and prolonged analgesia, but associated with sedative and haemodynamic effect (reduced B.P. and Heart rate) was also noted. It is necessary to monitor respiration, CVS Pulse - oximetry during this period. PCA (Patient controlled analgesia) is recently combined with epidural infusions and uite satisfactory results have been obtained by the use of fentanyl.

Subarchnoid block may be used in infants above 6 months and children. But there are reports of hypotension in younger age-groups, especiallybelow the age of 1 year.

Other regional blocks such as Intercostal block, Ilio-inguinal block, Iliohypogastric block and Penile block are quite useful blocks. Inter-pleural block also has been used, but is advocated above the age of 1 year.

Subcutaneous wound infiltrations with local anaesthetic solutions is a simple and useful method for post-opertive analgesia.

P.C.A. (Patient controlled analgesia) :

This technique is suitable for children above the age of 6-7 years, who can understand the use of P.C.A. -pump and can independently use it. For agegroups between 4-7 years "Parent-controlled analgesia" has been used to push the button of the PCA-pump.

Morphine - 0.02 mg - 0.3 mg/kg bolus dose with lockout interval of 7.

Infusion PCA - 0.15mg/kg/h with 4 hour limit.

Relief of acute pain in children is not without rewards, as Paeditric analgesia is the most satisfying experience for the clinician!

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