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EDITORIAL

Dr Sunil Mehendiratta
Editor in Chief
Neonatal Erythroderma: An approach to diagnosis

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Abstract

Neonatal erythroderma poses a diagnostic and therapeutic challenge as it is frequently misdiagnosed. The clinical and histological signs have poor specificity, without any specific feature characteristic of a cause thus delaying the etiological diagnosis. Erythroderma in neonatal period is more commonly the primary manifestation of numerous conditions in contrast to that in adults, where it is usually a secondary manifestation. This review outlines the clinical features of these disorders and suggests an approach to differential diagnosis and management.

Keywords: Erythroderma, exfoliative dermatitis

Introduction

Erythroderma is defined as diffuse erythema and scaling of skin involving more than 90% of the body surface area. Neonatal erythroderma poses a diagnostic and therapeutic challenge as it is frequently misdiagnosed. The clinical and histological signs have poor specificity, without any specific feature characteristic of a cause thus delaying the etiological diagnosis. Erythroderma in neonatal period is more commonly the primary manifestation of numerous conditions in contrast to that in adults, where it is usually a secondary manifestation. This review outlines the clinical features of these disorders and suggests an approach to differential diagnosis and management.

Incidence

Owing to the paucity of literature and retrospective nature of most of the available studies, the exact incidence of neonatal erythroderma is unknown. An Indian study comprising of 16,000 patients seen in a pediatric dermatology clinic over five years, 17 patients reported erythroderma, revealing an incidence of 0.11%.¹ Another study done in tertiary care hospital of India, also reported an incidence of 0.11% of neonatal and infantile erythrodermas in a total number of 19,000 pediatric patients treated over 6 consecutive years.²

Etiology

Neonatal erythroderma has several etiologies (Table 1). The most common cause was drugs (25%) in an Indian study by Sarkar et al on erythroderma in children, which was followed equally by ichthyosis, psoriasis and staphylococcal scalded skin syndrome (SSSS) (each in 18% patients).¹ In another study the reported causes were infections (40%), ichthyosiform erythrodermas (25%), atopic dermatitis (15%), infantile seborheic dermatitis (10%) and unidentified etiology in 10%.² A retrospective study done by Pruszkowski et al in France on 51 infants with erythroderma revealed the important causes to be immunodeficiency (30%), ichthyosis (24%), Netherton’s syndrome (18%) and eczematous or papulosquamous dermatitis (20%). The erythroderma was of unknown origin in 10% patients.³

Approach to a patient of neonatal erythroderma

Neonatal erythroderma is a diagnostic and therapeutic challenge. Delay in the establishment of the correct diagnosis can be fatal. The differential diagnosis of erythroderma is a multistep procedure. Clinical and histological clues along with laboratory tests help to reach an appropriate diagnosis. The important points to note in history include the age of onset, family history, consanguinity, failure to thrive, recurrent infections, associated constitutional or systemic features and any history of drug intake.

Transient neonatal dermatoses

Erythema toxicum neonatorum (ETN) is a benign self-limited eruption occurring primarily in healthy newborns in the early neonatal period. Onset is between 24 to 48 hours of life and is characterized by macular erythema, papules, vesicles, and pustules. The incidence ranges from 30% to 70% in various surveys.⁴ Lesions resolve spontaneously within 1 week without
any sequelae. Miliaria is a group of transient eccrine disorders. It is common in summer months and in infants housed in incubators.5

Miliaria rubra starts as non-follicular papules or papulovesicles which can progress to erythroderma.

Infectious causes

Staphylococcal scalded skin syndrome (SSSS)
Onset of erythroderma at birth should arouse a suspicion of infections, ichthyosis and immunodeficiency. Acute onset of erythroderma with fever and irritability suggest an infective etiology. Orange red macular exanthem or uniform erythema progressing to blistering and epidermal desquamation revealing moist underlying erythematous base along with skin tenderness should raise a possibility of SSSS (Figure 1). In generalized forms of SSSS, toxin diffuses from an infected focus (conjunctiva, umbilicus, nose, urine) and spreads by hematogenous route to produce its widespread effects.6

Icthyosis group of disorders

Neonatal erythroderma is a presenting sign of several hereditary disorders of keratinization which include isolated ichthyoses as well as syndromal ichthyoses. Newborns usually present with collodion membrane which eventually progresses to several congenital ichthyoses, including lamellar ichthyosis (LI), congenital ichthyosiform erythroderma (CIE) or self-healing collodion baby.9 The membrane is shed off revealing erythroderma with generalized fine scaling (Figure 2). Other associated cutaneous symptoms can include ectropion or eclabium, palmoplantar keratoses, scarring alopecia or onychodystrophy. Bullous congenital ichthyosiform erythroderma also known as epidermolytic hyperkeratosis presents with severe blistering immediately after birth and widespread erosions, accompanied by variously severe
ichthyosiform erythroderma. Harlequin ichthyosis is characterized by a thick, taut body armor-like covering that severely restricts movement and respiration, which usually leads to death. If the patient survives, they progress to erythroderma.

Figure 2: Congenital ichthyosiform erythroderma in a neonate

Ichthyosiform syndromes

Conradi-Hunnerman-Happle syndrome
It is an X-linked dominant disorder which presents with patterned ichthyosiform erythroderma along the blashko’s lines along with focal stippled calcifications in areas of endochondral bone formation.

Netherton’s syndrome
Non-specific erythroderma, which is more prominent over flexures along with hypotrichosis should point towards Netherton syndrome. It is an autosomal-recessive disorder caused due to SPINK5 mutation. The hallmark feature which help in differentiating it from others is trichorrhexis invaginata (bamboo hair) on hair shaft microscopy. Other features like icthyosis linearis circumflexa (double edged scaly plaques), hyper-IgE, diarrhea and atopy become apparent over time.

Chanarin-Dorfman syndrome
Also referred to as neutral lipid storage disease with ichthyosis, it is an autosomal-recessive disease which resembles congenital ichthyosiform erythroderma along with other features like mental retardation, cataract, sensorineural deafness and myopathy. Demonstration of lipid vacuoles in leucocytes on peripheral smear (Jordans anomaly) help in differentiating it from other CIE.

KID (keratitis-ichthyosis-deafness) syndrome
It presents with diffusely thickened erythematous skin at birth which peels off in first week of life. In later years, ichthyosis, kerato-conjunctivitis and deafness develop.

Papulosquamous disorders

Atopic dermatitis (AD)
AD presenting as neonatal erythroderma is rare. If present, however, acute lesions are characterized by widespread pruritic erythematous papules and patches with marked exudation over the face, trunk, scalp and extensors of extremities. Sparing of the axillae and napkin areas differentiates it from erythrodermic psoriasis and seborrheic dermatitis.

Psoriasis
Congenital erythrodermic psoriasis per se is rare. It may simulate either non-bullous ichthyosiform erythroderma or may evolve into generalized pustular psoriasis. Only 15 cases of congenital erythrodermic psoriasis have been reported. Positive family history for psoriasis and human leukocyte antigen (HLA) B17 is found in more than half of the patients and their relatives. It requires a thorough diagnostic workup to exclude other serious differential diagnoses, especially infections with herpes simplex virus (HSV), varicella zoster virus (VZV), Staphylococcus aureus or Candida spp and immediate treatment to avoid complications.

Pityriasis rubra pilaris (PRP)
PRP in neonates presents as salmon colored erythema and scaling similar to psoriasis. However, islands of sparing (“nappes claires”), follicular hyperkeratoses and cephalo-caudal spread differentiate it from the latter. Palmo-plantar sandal may or may not be present. Congenital erythrodermic pityriasis rubra pilaris has been described. It is inherited as an autosomal dominant trait and, unlike the acquired forms of pityriasis rubra pilaris, tends to run a life long course.

Seborrheic dermatitis (SD)
Yellowish greasy large scales present typically over seborrheic ares of scalp, neck, axillae, chest and napkin area is suggestive of seborrheic dermatitis. There is a considerable overlap between AD and SD.

Immunodeficiency disorders
Immunodeficiency must be suspected in cases of severe erythroderma with skin induration, severe alopecia, failure to thrive, infectious complications, or evocative histological findings.

Omenn’s syndrome is an autosomal recessive form of severe combined immunodeficiency with erythroderma, failure to thrive, lymphadenopathy and leucocytosis with prominent eosinophilia. Serum IgE is increased while levels of IgG, IgM, IgA are decreased. Histiocytic-appearing cells can be demonstrated in skin, lymph nodes, liver and spleen.

Graft-Versus Host Disease can rarely present as erythroderma in newborns with primary immunodeficiency who have received non-irradiated blood unknowingly, or maternal blood via placenta in-utero. It starts as non-specific morbiliform rash which progresses to erythroderma.

Leiner’s disease is used as an “umbrella” term to refer to group of disorders with erythroderma when
other causes have been ruled out. It was initially used to describe young infants with desquamative erythroderma, sparse hair, diarrhoea and failure to thrive. The dermatitis is associated with progressive erythema and erosions which later become generalized. It is considered to be caused by complement C5 deficiency or dysfunction.20

**Drugs**

Drug induced neonatal erythroderma are most commonly implicated to ceftriaxone and vancomycin. History of drug intake would give a diagnostic clue. Prognosis is good, if the drugs are withdrawn immediately.21

**Metabolic causes**

Holocarboxylase synthetase deficiency is an autosomal recessive condition which presents with lactic acidosis in the neonatal period, sharply demarcated dermatitis plaques which progress to erythroderma, alopecia, severe bacterial and viral infections and neurological abnormalities.22

**Others**

**Diffuse cutaneous mastocytosis**

It is yet another rare cause of neonatal erythroderma that manifests at birth or shortly thereafter. Diffuse infiltration of the skin with mast cells leads to widespread yellow–reddish erythema with occasional bullae formation (Figure 3). Episodes of flushing, diarrhoea and a positive Darriers sign support its diagnosis. The child should be looked for lymphadenopathy, hepatosplenomegaly and bone marrow infiltration with mast cells to rule out systemic mastocytosis.23

![Figure 3: Generalized cutaneous mastocytosis in a new born](image)

**Laboratory investigations**

Various investigations need to be done in a case of erythroderma (Table 2). Mild anemia, leukocytosis, increased erythrocyte sedimentation rate, hypoalbuminemia, hyperglobulinemia, and hyperuricemia are frequent findings. Increased IgE may be observed in erythroderma when caused by atopic dermatitis and drug reactions, although it has also been reported in other settings. According to the clinical diagnosis suspected potassium hydroxide preparation, swabs from skin or eyes, nose, umbilicus, blood culture, Gram stain, complete blood counts, hair mount, total IgE levels and quantitative immunoglobulins, eosinophil count and holocarboxylase assay may need to be done.

**Table 2: List of investigations to be done in a case of neonatal erythroderma**

<table>
<thead>
<tr>
<th>Investigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete blood count with peripheral smear</td>
</tr>
<tr>
<td>Erythrocyte sedimentation rate</td>
</tr>
<tr>
<td>Absolute eosinophil count</td>
</tr>
<tr>
<td>Serum electrolytes</td>
</tr>
<tr>
<td>Liver function tests, kidney function tests</td>
</tr>
<tr>
<td>Total protein/albumin</td>
</tr>
<tr>
<td>Blood sugar levels</td>
</tr>
<tr>
<td>Chest x ray</td>
</tr>
<tr>
<td>Urine routine and culture</td>
</tr>
<tr>
<td>Serum IgE</td>
</tr>
<tr>
<td>Skin swabs for culture and sensitivity (affected areas, nose, perineum, axilla)</td>
</tr>
<tr>
<td>Grams stain</td>
</tr>
<tr>
<td>KOH mount</td>
</tr>
<tr>
<td>Tzanck smear</td>
</tr>
<tr>
<td>Blood culture (fungal and bacterial)</td>
</tr>
<tr>
<td>Hair shaft microscopy</td>
</tr>
<tr>
<td>Skin biopsy</td>
</tr>
<tr>
<td>Biotinidase, holocarboxylase and essential fatty acids assays</td>
</tr>
</tbody>
</table>

The histopathology of exfoliative dermatitis often reveals a nonspecific picture consisting of orthokeratosis (hyperkeratosis, parakeratosis), acanthosis, and a chronic perivascular inflammatory infiltrate with or without eosinophilia. Botella-Estradas et al observed that the clinicopathologic correlation in erythroderma is difficult, because the specific features of the dermatosis are masked by the nonspecific
### Table 3: Neonatal erythroderma: Clues to diagnosis

<table>
<thead>
<tr>
<th>Clinical clues</th>
<th>Histological clues</th>
<th>Laboratory tests</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Infective</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SSSS: skin tenderness, fever, bullous lesions, positive nikolsky’s sign</td>
<td>Superficial split below granular layer</td>
<td>Skin swab Blood culture (usually negative)</td>
<td>IV antibiotics (flucloxacillin, amoxycillin/ clavulanic acid)</td>
</tr>
<tr>
<td>TSS: fever, hypotension, blanching erythema, palmo-plantar desquamation</td>
<td>Superficial perivasular and interstitial neutrophilic infiltrate</td>
<td>Skin swab Blood culture (negative)</td>
<td>IV antibiotics (flucloxacillin, amoxycillin/ clavulanic acid), IVIG</td>
</tr>
<tr>
<td>CCC: Maternal vaginal candidal infection, papules and pustules, palmo-plantar involvement</td>
<td>Pseuduhyphae and spores in stratum corneum on PAS stain</td>
<td>KOH: Pseuduhyphae Fungal culture (blood, urine)</td>
<td>Topical antifungals (miconazole, nystatin), IV amphotericin B</td>
</tr>
<tr>
<td><strong>Icthyosis</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CIE/NBIE: Collodion membrane, ectropion, eclabium</td>
<td>Hyperkeratosis, acanthosis, minimal lymphocytic infiltrate</td>
<td></td>
<td>Emollients, retinoids may be needed later</td>
</tr>
<tr>
<td>BIE: Blistering, erosions, maceration at flexures</td>
<td>Epidermolytic hyperkeratosis</td>
<td></td>
<td>Emollients</td>
</tr>
<tr>
<td>Nethertons: Erythroderma at flexures, ichthyosis linearis circumflexa, hypotrichosis, atopy, diarrhea</td>
<td>Psoriasiform acanthosis, parakeratosis, perivascular lymphocytic infiltrate</td>
<td>Hair shaft microscopy: Bamboo hair, Raised IgE, eosinophilia</td>
<td>Emollients</td>
</tr>
<tr>
<td>Conradi-hunnerman: Erythroderma along blashko’s line</td>
<td>Hyperkeratosis, reduced granular layer</td>
<td>X ray: Stippling</td>
<td>Emollients</td>
</tr>
<tr>
<td>Chanarin-dorfman: Erythroderma, mental retardation, deafness, myopathy</td>
<td>Hyperkeratosis with a diminished granular cell layer</td>
<td>Lipid vacuoles in leucocytes on peripheral smear (Jordans anamoly)</td>
<td>Emollients</td>
</tr>
<tr>
<td><strong>Papulosquamous disorders</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atopic dermatitis: Exudative plaques, atopy, hyperlinearity, sparing of axillae and napkin area</td>
<td>Spongiosis, eosinophils in dermis, exocytosis</td>
<td>Raised IgE, Eosinophilia</td>
<td>Low potent topical steroids, oral steroids, cyclosporin in severe cases</td>
</tr>
<tr>
<td>Seborrhic dermatitis: Greasy yellow plaques, cradle cap</td>
<td>Parakeratosis, spongiosis, neutrophils at tips of follicular ostia</td>
<td></td>
<td>Topical antifungal + low potency steroid</td>
</tr>
<tr>
<td>Psoriasis: Resembles NBIE, positive family history</td>
<td>Prakeratosis, munro’s abscess, suprapapillary thinnin, regular acanthosis</td>
<td></td>
<td>Emollients (white soft paraffin), Retinoids, Methotrexate may be needed</td>
</tr>
<tr>
<td>PRP: Islands of sparing (nappes claires)</td>
<td>Alternating orthokeratosis and parakeratosis (checker board pattern)</td>
<td></td>
<td>Emollients (white soft paraffin), oral retinoids may be needed</td>
</tr>
<tr>
<td>Mastocytosis: yellow reddish erythema, bullous lesions, positive Darrier sign</td>
<td>Abundant mast cells in papillae dermis (toluidene blue stain)</td>
<td>Tissue smear: mast cells, eosinophils</td>
<td>H1, H2 antihistamines, avoidance of codeine and massage</td>
</tr>
<tr>
<td>Immunodeficiency (Omenn syndrome): Failure to thrive, alopecia, recurrent infections</td>
<td>Activated T ells, histiocytes, eosinophils, CD 25, CD45RO+</td>
<td>Raised IgE, eosinophilia, decreased B cells</td>
<td>Supportive care, bone marrow transplant</td>
</tr>
<tr>
<td>Drug induced: History of drug intake</td>
<td>Vascular change, necrotic keratinocytes, eosinophils</td>
<td></td>
<td>Stop the offending drug</td>
</tr>
<tr>
<td>Metabolic Multiple carboxylase deficiency: Sharply demarcated dermatitis over scalp, eyebrows, perioral, perianal areas, alopecia, infections</td>
<td></td>
<td>Ketoacidosis, holocarboxylase enzyme assay</td>
<td>Oral biotin</td>
</tr>
</tbody>
</table>
features. Few histological clues however help in clinic-pathological correlation which have been mentioned in Table 3.

**Treatment**

Erythroderma is a dermatological emergency and needs hospitalisation. The initial management of all types of erythroderma is the same regardless of the etiology. Secondary infection, dehydration, electrolyte imbalance, temperature dysregulation, and high-output cardiac failure are potential complications in all cases. The principle of management is to maintain skin moisture, avoid precipitating factors, apply topical steroids, and treat the underlying cause and complications. Every case requires regular monitoring of protein, electrolyte balance, circulatory status, and body temperature. The patient should be kept in a specialized environment with a room temperature of 30-32 degree Celsius. Extreme cooling or overheating should be avoided. Hourly records of heart rate, respiratory rate and blood pressure should be kept along with daily input/output charting. Reduction in urine output with increased heart rate and respiratory rate are indicators of septicemia. Intravascular fluid loss should be immediately replaced. Barrier nursing should be followed and skin swabs should be sent on alternate days. Mild, soothing topicals, wet dressings and steroids should be used wherever necessary. Once the acute irritated skin is taken care of, specific treatment according to the etiology should be initiated (Table 3). Both the pediatrician and the dermatologist should work in collaboration to avoid mismanagement of the patient.

**Prognosis**

The prognosis for patients with exfoliative dermatitis depends primarily on the cause of the disease, though often this remains unknown. The prognosis was poor with a mortality of 16% in the study done by Pruszkowski et al.3 Erythrodermas due to drugs, infantile seborrheic dermatitis, nutritional deficiencies and Staphylococcal scalded skin syndrome respond well to treatment. Psoriatic, ichthyotic and atopic erythroderma are difficult to manage as they might require long term treatment (retinoids, methotrexate or steroids) which hamper the development and growth of the child. Drug induced erythroderma has good prognosis on immediate withdrawal of the drug.

**Conclusion**

Neonatal erythroderma have several etiologies, both benign and fatal. Early and precise diagnosis is important for proper management of the child. A combined effort of both a pediatrician and a dermatologist is needed for the same.

**References**


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Dr VP Goswami Dr Alok Bhandari Dr Mahavir Jain
Skin Care of Newborn

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Abstract

Skin is an important but complex multifunctional organ. In this article its anatomy, development and its role in post natal adaptation is discussed. Factors responsible for skin injury and its preventive care is also reviewed.

Keywords: skin, neonate, newborn, trauma

Normal Anatomy of the Skin

The skin is a complex, multifunctional organ. It consists of three main layers, the epidermis, dermis and the subcutaneous layer. The majority of skin is composed of the dermis and consists of collagen embedded in a hydrated matrix of glycosaminoglycans. Blood vessels and majority of cutaneous nerve endings are present in the dermis. The cells of the dermis and subcutaneous fat are derived from the embryonic mesoderm. In contrast, epidermal appendages including hair follicles, sweat glands, and sebaceous glands, are derived from embryonic ectoderm.

The epidermis is a highly complex tissue composed of multiple cell types, including keratinocytes, melanocytes, Merkel cells, and Langerhans cells. Only the antigen presenting Langerhans cells are of mesodermal origin. The epidermis is composed of four layers.

1) The stratum basale, which is responsible for keratinocyte proliferation and epidermal renewal.
2) The stratum spinosum, which consists of tightly packed keratinocytes linked via desmosomal connections.
3) The stratum granulosum, which is responsible for barrier lipid synthesis and corneocyte production via programmed cell death.
4) The anucleated outermost layer, the stratum corneum, which forms the physical interface with the environment.

The stratum corneum is formed generally after 23 to 24 weeks’ gestation.

Development of barrier function

At birth, full-term neonates have competent barrier function. It undergoes a maturation process through at least the first year of life. Preterm infants have a skin barrier that is underdeveloped compared with full-term neonates. In one study, the epidermal thickness of full-term neonates at birth was 43 ± 7 μm versus 31 ± 7 μm for preterm infants (24–30 weeks of gestation).

In vitro culture systems of human skin require lifting to an air-liquid interface to elicit stratum corneum formation and the development of a competent epidermal barrier. One unanswered question in fetal skin development is the mechanism whereby the fetus develops a fully functional epidermal barrier under total aqueous conditions. Recent work implicates the vernix caseosa in this process.

Vernix caseosa (a product of sebaceous secretions) participates in regionally “water proofing” the skin surface, thereby allowing cornification to occur initially in the area of the hair follicles and then over the interfollicular skin. Vernix is progressively released from the skin surface after formation of an intact stratum corneum under the influence of pulmonary-derived surfactant within the amniotic fluid. The detached vernix is subsequently swallowed by the fetus. Of interest, measurements of free amino acids in vernix have demonstrated that it is particularly rich in glutamine, a known trophic factor for the developing gut. The surge in sebaceous gland activity during the last trimester of pregnancy leads to production of a thick, lipid-rich, hydrophobic film (the vernix caseosa) overlying the developing stratum corneum.

Exposure to antenatal steroids has been shown to accelerate maturation of the epidermal barrier in rodents, but similar results has not been demonstrated in human fetus.
Postnatal adaptation
The skin must immediately perform multiple functions vital to survival of the organism. Many of these functions, such as thermoregulation, were unnecessary prior to birth and were largely performed by the placenta. Birth, however, marks a transition to a cold, non-sterile environment that includes high oxidative stress and exposure to ultraviolet light. A number of physiologic mechanisms in the epidermis contribute to formation of a tough but resilient and adaptive environmental interface. These mechanisms include the production of sweat, which is important for thermoregulation and bacterial homeostasis, as well as sebum production by hyperplastic sebaceous glands. The epidermal barrier is initially pH neutral, but it rapidly develops surface acidity via mechanisms distinct from simple bacterial colonization. Stratum corneum, possess the dual properties of renewability and self-cleaning through the distinct but coupled processes of cornification and desquamation. Recent data have clearly indicated the importance of transepidermal water flux as a regulator of both DNA and lipid synthesis within the epidermis. The preterm infant is markedly deficient in all of these physiologic mechanisms.

Functions of skin
- Barrier to water loss, chemicals
- Thermoregulation
- Infection control
- Immune-surveillance
- Acid mantle formation
- Antioxidant function

The Special Case of the Preterm Infant
The VLBW preterm infant suffers from various structural and functional deficits relating to the formation of a competent epidermal barrier. Premature infant has significantly fewer layers of stratum corneum than term infants and the skin appears ruddy and transparent. Infants below 30 weeks of gestation may have less than 2 to 3 layers of stratum corneum compared with 10 to 20 layers in adults and term newborns. Trans-epidermal water loss (TEWL) decreases dramatically with advancing gestational age. TEWL in the near-term infant is equal to or less than that seen in adults. Measurement of TEWL as a function of postnatal age in preterm infants reveals a relatively rapid decrease over the first week of life. At 28 days postnatally, however, the TEWL is still high compared with term infants or adults, indicating continued compromise of the epidermal barrier.

The development of the acid mantle in humans begins at birth. Among the multiple mechanisms are hydrolysis of triglycerides, lactate generation, production of natural moisturizing factor, and active proton pumps within the nucleated epidermis. The formation of an acid mantle is believed to be important for the proper organization of barrier lipids within the stratum corneum as well as possible regulation of bacterial colonization. VLBW infants whose birth weights are less than 1,000 g develop an acid mantle more slowly than older infants.

Risk factors for skin injury
- Prematurity
- Use of monitoring equipments
- Adhesives used to secure central or peripheral access lines, endotracheal tube
- Edema
- Immobility secondary to muscle relaxants, high frequency ventilation, extracorporeal membrane oxygenation which can cause pressure necrosis
- Use of medications like vasopressors, calcium, sodium bicarbonate
- Use of nasal prongs or masks for nCPAP
- Devices with potential for thermal injury such as radiant warmers. Temperature of any product in contact with the skin should not be more than 41°C.

Assessment of skin injury:
Preventing pressure ulcers is an important aspect of care in preterm infants. In this population pressure ulcer is a serious yet preventable iatrogenic injury. Initiating pressure ulcer prevention strategies for at-risk patients, rather than all patients, will optimize the appropriate use of resources.

Quingley and Curley in 1996 developed the Braden Q Scale for Predicting Pediatric Pressure Ulcer Risk by adapting the adult-based Braden Scale for Predicting Pressure Sore Risk (Bergstrom, Braden, Laguzza and Holman, 1987). The Braden Q Scale includes the six original Braden subscales (mobility, activity, sensory perception, moisture, friction and shear, and nutrition) and it also adds a seventh subscale, that is, tissue perfusion/oxygenation. The Braden Q Scale was validated in 2003 in a multisite prospective cohort descriptive study of 322 pediatric intensive care patients who were on bed rest for at least 24 hours. The Braden Q Scale was validated in pediatric patients 3 weeks to 8 years of age. All seven subscales are rated from 1 (least favorable) to 4 (most favorable); patients receive only one score per subscale. Total Braden Q Scale scores range from 7 (highest risk) to 28 (lowest risk), with a score of 16 or lower identifying pediatric patients at risk for pressure ulcers. At a score of 16, the sensitivity of the Braden Q Scale is 88% and the specificity is 58%. The scale is not validated for preterm
or neonatal population below 21 postnatal days and it does not predict device-related pressure sores. The patient is considered “at risk” if the total score is less than 16 and appropriate nursing interventions should be implemented based upon the most “at-risk” subscale.16

The Neonatal Skin Condition Score (NSCS) was developed in 2007 through the collaboration of the National Association of Neonatal Nurse (NANN) and the Association of Women’s Health, Obstetric and Neonatal Nurses (AWHONN) for use in newborn from birth till 28 days of age. The scale evaluates overall skin condition and may be linked to actions like consultation with skin team, emollient use, skin culture, etc. The validity and reliability were demonstrated in a sample of 2,820 neonates including ELBW infants (Lund & Osborne 2004).1

Table 1: Neonatal Skin Condition Score (NSCS)

<table>
<thead>
<tr>
<th>Score</th>
<th>Dryness</th>
<th>Erythema</th>
<th>Breakdown</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>normal, no sign of dry skin</td>
<td>no evidence or erythema</td>
<td>none evident</td>
</tr>
<tr>
<td>2.</td>
<td>dry skin, visible scaling</td>
<td>visible erythema, &lt;50% body surface</td>
<td>small, localized areas</td>
</tr>
<tr>
<td>3.</td>
<td>very dry skin, cracking/fissures</td>
<td>visible erythema, ≥50% body surface</td>
<td>extensive</td>
</tr>
</tbody>
</table>

Score 1-3 for each category: Perfect Score = 3, worst score = 9.

Device related pressure injuries, particularly the nasal injuries seen in babies receiving nasal CPAP, are a common cause of skin breakdown observed in NICU. There is currently no recognised classification available to describe the severity of nasal trauma secondary to nasal CPAP in neonates. Commonly the classification of the decubitus lesions from the US National Pressure Ulcer Advisory Panel (NPUAP) is used for staging the severity of these injuries.18

1. Stage I: erythema not blanching, on an otherwise intact skin
2. Stage II: superficial ulcer or erosion, with partial thickness skin loss.
3. Stage III: necrosis, with full thickness skin loss.

Care of newborn skin

Bathing

Skin cleansing products contain surfactants which removes dirt and soils with rinsing. Surfactants can emulsify lipids, which could result in damage to the subcutaneous lipids, increasing skin permeability and causing skin irritation. Initial bath should be performed after the temperature has been stabilised, usually after 2 to 4 hours after admission. In preterm infants bathing is often deferred in the first 24 hours. Use of mild nonalkaline, preservative free soap is recommended for bathing. Daily bathing is not indicated. Use of warm sterile water is sufficient for premature infants. No more than two to three baths per week is required. Use of liquid products with very low irritancy surfactants, minimizing the amount, and rinsing well are recommended for bathing the infants. “Over bathing” (i.e., multiple exposures in a short period) is to be avoided.14

Cord care

Recommendations for care of umbilical cord vary from dry cord care to use of various dyes, alcohol, soap and water or antiseptics. But there is concern regarding the potential toxic effects of dye and antiseptics, which led to adopt the dry cord care method. Unfortunately this method may be associated with increased risk of omphalitis. A randomised trial of use of chlorhexidine for cord care in Nepal demonstrated a reduction in the incidence of omphalitis as well as neonatal mortality19. Two other RCTs done in Bangladesh and Pakistan also had similar results20, 21. Because omphalitis is rare, and its severe complication necrotising fasciitis is even rarer, large trials are needed to determine which cord care regimen is best for preventing these complications. Until the results of such trials are available, there is no clear advantage of one regimen over the other. Care providers need to encourage parents to report any redness around the cord for early diagnosis of omphalitis22.

Use of adhesives

Use of adhesives and tapes should be minimised in the NICU. It can cause skin tearing after removal. It can significantly increase trans-epidermal water loss upon removal. Rather, the practice of use of non-adhesive
products in conjunction with transparent dressing and double backed tape is to be encouraged. Warm sterile saline should be used to remove adhesives from skin to prevent skin stripping. A pectin-based barrier may be used under the tape as it can provide effective adhesion for certain appliances and also protects the skin from damage caused by tape removal.23,24

Use of emollients
The skin barrier of the premature newborn is compromised which contributes to the increased susceptibility to infections and hence morbidity and mortality. Newborn oil massage is an intervention that has been a traditional practice in the Indian subcontinent. It acts by augmenting the mechanical barrier and also is a source of essential fatty acids like linoleic acid. Topical vegetable oils particularly coconut oil, mustard oil and others like sunflower, sesame, olive, and soybean oils are also commonly used as emollients. Topical emollient therapy has been shown to reduce mortality and hospital acquired infections significantly and their use is also associated with improved weight in preterm infants. Though Cochrane review for use of topical emollient in preterm infants did not find any significant reduction in mortality or invasive infections, infants massaged with vegetable oil had a higher rate of weight gain, linear growth, and head growth. Use of coconut oil application was also found to reduce TEWL without increasing skin colonization in VLBW neonates.27,28,29,30,31,32,33

A recent randomized controlled trial conducted in preterm VLBW babies using topical coconut oil application twice a day for the first week of life, was found to reduce the TEWL by as much as 46% in this vulnerable population. The intervention could reduce initial weight loss, promote better growth, and reduce fluid requirements.34

Use of disinfectants
Isopropyl alcohol or other alcohol based disinfectant can cause tissue damage in VLBW infants and their use is discouraged in VLBW infants till the stratum corneum matures. Povidone iodine and chlorhexidine are recommended for use, and the solution should be completely removed after the procedure with saline to avoid systemic absorption. Repeated and prolonged use of iodine containing disinfectant may affect thyroid function in premature infants. It can also cause skin irritation and tissue damage. There is high-quality evidence that chlorhexidine skin or cord care in the community setting results in a 50% reduction in the incidence of omphalitis and a 12% reduction in neonatal mortality. No significant side effects specific to chlorhexidine has been described.26

Humidity
Infants below 32 weeks of gestation and/or below 1200 gm are frequently nursed inside humidified incubator. Use of incubator in these infants is associated with a reduction in insensible water loss and fluid requirements, maintenance of skin integrity, and maintenance of sodium homeostasis. During humidification, strict equipment cleaning protocols to be followed. An increased risk of pseudomonas infection has been described with the use of incubator humidification.35 Recommended relative humidity is 75% to 80% for the first 7 days and decreasing to 50% to 60% during the second week.

Use of transparent plastic covering
Use of thin plastic blanket may be effective in reducing evaporative water in premature infants. It diminishes an infant’s exposure to convective air currents while being nursed on an open radiant warmer bed. The occlusive wrap must be made of polyethylene rather than polyurethane because only polyethylene transmits the long wavelength energy of radiant heat. A clinical trial done using occlusive wrapping with polyethylene at birth without drying found that it reduced postnatal fall in temperature of very immature infants by reducing evaporative and convective heat loss and was more effective as compared to conventional drying and exposure. After stratified analysis it was seen to be more effective in 23–27 weeks of gestation.23,30 Another randomized trial done using a thin plastic film made of food grade plastic to cover the bassinet of the neonate during the first week of life reported reduced heat loss and decreased episodes as well as degree of hypothermia in neonates nursed under this thin film as compared to the control group.37

Intravenous extravasations and infiltration
Intravenous site extravasations commonly occur after infusion of hyperosmolar solutions like sodium bicarbonate, IV calcium preparation, higher dextrose concentration (more than 12.5%) and vasoconstrictors. Hourly IV site assessment and documentation of skin integrity are crucial to avoid extravasations/ infiltration. Peripheral IV infusion should not exceed 12.5% dextrose concentration. Central venous access is to be sought whenever using vasoconstrictors or other potentially high risk medications. Whenever an infiltration occurs, the infusion should be stopped immediately and the limb should be elevated. Heat or cold should not be applied as this may cause further tissue injury. Magnesium sulphate with glycerine may be considered to reduce the edema in cases of cellulitis. Hyaluronidase
is used to treat infiltration or extravasations of hyperosmolar or alkaline solutions. Phenolamine may be used to treat injury caused by extravasations of vasoconstrictor agents like dopamine, dobutamine, epinephrine etc. Plastic surgery consultation should be sought for severe injury.

Wound care

Wounds in the neonatal period are a common occurrence after surgical procedures, trauma particularly in infants receiving continuous positive airway pressure using nasal prongs or masks, contact dermatitis, or excoriation. Epidermal stripping is common, particularly after use of adhesives or tapes. It can be avoided by minimising the use of adhesives and using protective barriers. Frequent assessment of the wound and effective treatment promotes wound healing. Optimal wound treatment is achieved through proper assessment, cleansing and dressing. Use of antiseptics over open wound is to be avoided. Normal saline is the preferred cleansing agent to remove debris and necrosed tissue. Moistening the wound every 4 to 6 hourly until the surface is clear facilitates healing. Occlusive, non-adherent dressings provide a moist environment to promote healing and protect the site from further injuries. Various hydrocolloid, hydrogel and barrier cream are used to facilitate wound healing.

A special care has to be put to avoid pressure injuries particularly the nasal injuries commonly seen in infants on nasal CPAP.38

1. Use of appropriate sized prongs to make an effective seal for the transmission of pressure
2. Avoidance of pressure on the nares to create a seal
3. Suction and inspection of the skin every 4 hours
4. Instillation of normal saline into the nostril every 4 hourly to minimise crusting.
5. Access to and use of equipment manual to understand and utilize practices related to securing the device.

Conclusions

Skin is an extremely important organ in newborns especially preterm babies. Understanding its development with gestation and with postnatal age will help in preventing skin injuries and associated complications.

References

5. Shaul Dollberg and Steven B. Hoath. Temperature Regulation in Preterm Infants: Role of the Skin-Environment Interface, NeoReviews 2001;2:282

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**Workshops on Non-Invasive & High Flow Ventilation**

National Neonatology Forum (NNF) in support with UNICEF successfully conducted two workshops on Non-Invasive & High Flow Ventilation held on 20-21 June & 22-23 June 2016 at Swami Dayanand Hospital, Dilshad Garden, New Delhi. The faculty for the workshops were from Oxford University Hospitals, Boston, U.K. and Indian Faculty. This training provides the platform to sensitize and practice the skills that are required to take care of admitted neonates.
The Obstetric Ultrasound: A neonatologist’s perspective

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Abstract
Obstetric ultrasound is a vast topic, covering various aspects of fetal, maternal and placental physiology. It is pertinent for a Neonatologist to be aware of the common fetal conditions for which expert opinion is often sought for. The optimum management of a high risk neonate starts in fetal life and for this a close collaboration between the Neonatologist, Obstetrician and the Radiologist is vital. In the following review article the role of ultrasound in diagnosis various fetal anomalies is discussed.

Keywords: neonate, newborn, fetus, ultrasound

The obstetric ultrasound -
A neonatologist’s perspective

Learning objectives
1. What are the types of imaging techniques available?
2. How safe are they?
3. Fetal anomaly screening -
   • What are the common anomalies that a neonatologist might be asked to give his opinion on?
   • What all are the differential diagnosis of the various signs?
   • What is the prognosis if some fetal anomaly is detected antenatally?
   • How to follow up an abnormal fetal scan?
   • What all are the therapeutic options that can be advised antenatally?

Fetal imaging techniques
The various imaging techniques that are available include - Ultrasonography (M-Mode, 2 D, 3D, 4D, Colour doppler, Spectral doppler ), Magnetic Resonance Imaging (MRI) and Computed Tomography(CT). Where as 2-D ultrasonography is the most commonly used modality, others such as Doppler scan and MRI might come handy in certain situations.

Table 1: Various fetal imaging techniques.

<table>
<thead>
<tr>
<th>Imaging Modality</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-Mode /2D Ultrasound</td>
<td>It is the standard method of fetal imaging</td>
</tr>
<tr>
<td>M-Mode</td>
<td>It has limited uses. It can be used to diagnose fetal arrhythmias, pericardial effusion and to assess myocardial contractility of the fetus</td>
</tr>
<tr>
<td>Doppler Ultrasound</td>
<td>It is used to demonstrate the presence, velocity, and direction of blood flow. Color Doppler is useful in assessing cardiac outflow tracts, various arterial/ venous structures and is one of the most important modality used to monitor IUGR and Rh isoimmunised fetuses.</td>
</tr>
<tr>
<td>3D Ultrasound</td>
<td>There are a few studies comparing 2D and 3D ultrasound. In a large study it was found that 3D USG gave additional information in about 61% of cases when compared with 2D scan alone(^1). The additional information was related to facial anomalies, limb defects and neural tube defects. But many of the other studies have shown that these additional information does not alter the management per se(^2). As of now, 3D should be used only as an adjunct to 2D scan for providing further information in fetal abnormalities.</td>
</tr>
</tbody>
</table>

Introduction
Neonatology is a discipline that covers both the aspects of perinatology and neonatology. Neonatologists are required to frequently work in close collaboration with their obstetric and radiology counter parts in a variety of situations. One of the common scenarios encountered by a Neonatologist is an abnormal fetal scan. Unless one has thorough knowledge about antenatal scan, it would be very difficult to give the right advice. Timely interventions can be life saving in certain cases such as that of Rh isoimmunisation and fetal Intra uterine growth retardation (IUGR). The objective of this article is to give a brief overview of perinatal imaging, with special emphasis on aneuploidy screening and the various congenital anomalies that are detected antenatally.

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MRI is considered safe beyond the 1st trimester. It is usually avoided in the 1st trimester, but if the alternative modality available is CT, then MRI is the preferred choice. It might be useful in cases of maternal obesity or oligohydramnios where ultrasonography might not give a clear picture. Gadolinium is a relatively contraindicated in pregnancy.

CT-Scan Use of CT scan is very limited in pregnancy. It was employed only in the evaluation of acute abdomen when ultrasonography was not useful. Exposure to a radiation dose of 5 rads is associated with 1st trimester abortion and exposure in the 2nd trimester is associated with childhood cancers. Presently MRI is chosen over CT scan in situations where ultrasonography is not helpful.

Safety of ultrasonography in pregnancy

The exposure of fetus to ultrasound is known to increase the fetal temperature. Animal studies have shown that exposure of fetuses to hyperthermia results in various anomalies such as anencephaly, microcephaly, microphthalmia and cataract. But till date there are no strong studies showing any adverse effect of ultrasound on human fetuses. Majority of the studies that have reported some or the other adverse fetal effects have been done prior to 1990. Various Authorities tend to side on the line of caution and have strict guidelines on the use of ultrasound in pregnancy. The various factors that are to be considered when it comes to the safety of ultrasound in fetuses are - the gestational, dwell time and mode that is used. Earlier the gestation, the higher will be the risk. Dwell time is the time for which the ultrasound scan is done and the time is dependent on a parameter called thermal index which would usually be displayed in the machine. In the order of increasing frequency, the modes that produce the highest increase in fetal temperature are as follows: B-Mode, M-Mode, Color doppler and spectral doppler respectively.

The British Medical Ultrasound Society has laid down strict guidelines for the use of ultrasound in pregnancy which also specifies the thermal index and the respective dwell time. The dwell time for a thermal index of 0.7 is 60 minutes whereas that for a thermal index of 2.5°C is as low as 1 minute.

These are the general guidelines that are to be followed when it comes to fetal ultrasonography:

- A maximum temperature rise of no more than 1.5°C

Table 2: Soft markers of aneuploidy

<table>
<thead>
<tr>
<th>Marker</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuchal translucency (NT)</td>
<td>1. It is the subcutaneous edema that is observed in fetuses with trisomies</td>
</tr>
<tr>
<td></td>
<td>2. NT increases with advancing gestation and hence it is measured and compared with crown lump length (CRL)</td>
</tr>
<tr>
<td></td>
<td>3. A NT more that 95% confidence interval for the CRL is considered abnormal; NT &gt;99% will not alter that much with CRL and the value is 3.5 mm</td>
</tr>
<tr>
<td></td>
<td>4. Training is of utmost importance as small errors (even as small as 0.5 mm) can change the sensitivity by a significant margin</td>
</tr>
<tr>
<td></td>
<td>5. With a baseline risk of 1/300 and false positivity rate of anywhere between 5-8%, the sensitivity of NT in detecting Trisomy 21 can vary anywhere between 77 - 82%</td>
</tr>
<tr>
<td>Nasal bone</td>
<td>Nasal bone is usually seen by 11 weeks of gestation. The incidence of this finding in normal fetuses varies according to the race. Trisomy 21 fetuses have a very high rate of nasal bone absence. In combination with NT, this marker helps in decreasing the false positivity rate to 2.5% without increasing the sensitivity</td>
</tr>
<tr>
<td>Flattened facies</td>
<td>The frontomaxillofacial angle is increased in fetuses with trisomy 21 (&gt;85°) compared with normal fetuses</td>
</tr>
<tr>
<td>Doppler parameters</td>
<td>Reversed wave in ductus venosus and tricuspid regurgitation have been evaluated in screening for trisomy 21 in the 1st trimester</td>
</tr>
<tr>
<td>Femur and humeral length</td>
<td>1. Femur is shorter in trisomy 21 and is measured against Biparietal Diameter (BPD). A ratio of expected to observed length of less than 0.91 has a sensitivity of 40% with a false positivity rate of 5%</td>
</tr>
<tr>
<td></td>
<td>2. Similar to femural length, the ratio of expected to observed humerus length of less than 0.9 has a sensitivity of 50% with a FPR of 6%</td>
</tr>
<tr>
<td>Mild pyelectasis</td>
<td>Anteroposterior diameter of more than 4 mm is observed in approximately 20% of trisomy 21 fetuses compared to 2% in normal fetuses</td>
</tr>
<tr>
<td>Echogenic bowel and Echogenic intracardiac foci (EIF)</td>
<td>1. Echogenic bowel has a variety of differential diagnosis, one of which is trisomy 21. The prevalence of this finding can be anywhere between 3 to 27% in trisomy 21 and about 5% in normal fetuses</td>
</tr>
<tr>
<td></td>
<td>2. Echogenic intracardiac foci is not a useful marker in fetuses of Asian origin as its prevalence in normal euploid fetuses is also very high</td>
</tr>
<tr>
<td>Structural anomalies</td>
<td>Structural anomalies such as duodenal atresia, cardiac defects and ventriculomegaly might serve as additional markers of trisomy 21</td>
</tr>
</tbody>
</table>

Genetic sonography is best used by combining it with a priori risk calculated based on maternal quad screen.
C above normal physiologic levels (37° C) should be preferred and a temperature rise of 4° C above normal temperature for even as low as 5 minutes is hazardous.

- Spectral Doppler ultrasound produces the maximum temperature rise, and routine Doppler examination during the embryonic period should not be done.
- Nonmedical use of ultrasound should not be done.

**Fetal anomaly screening**

The common anomalies that Neonatologist are asked to opine on include:

1. **Soft markers of aneuploidy**
2. **Central nervous system anomalies**
3. **Cardiovascular system anomalies**
4. **Gastrointestinal system anomalies**
5. **Renal and urinary tract anomalies**

Apart from these anomalies, the other commonly encountered fetal conditions include:

- Immune Hydrops
- Intrauterine growth retardation with doppler anomalies
- Multifetal pregnancy - Determining chorionicity, Diagnosis of twin to twin transfusion syndrome

**Soft markers of aneuploidy**

The various aneuploidies that end up in viable births include Trisomy 21, Trisomy 18, Trisomy 13 and Turner’s Syndrome. The rates of all the above mentioned Trisomies have been increasing since the past 2 decades primarily because of an increase in maternal reproductive age. The baseline rates of the trisomies are:

- 1/500 (Trisomy 21)\(^{12}\),
- 1/5000 (Trisomy 18),
- 1/10000 (Trisomy 13)\(^{13}\). Out of these trisomies, fetal death occurs in 20-30% of Trisomy 21 and approximately 80% of Trisomy 18 and 13\(^{14,15}\). Antenatal ultrasonography as a non-invasive modality plays a vital role in detecting the aneuploidies and hence offering the mothers an option of aborting the fetus early on. These ultrasonographic markers are usually combined with maternal serum markers and a risk is estimated. Based on the risk either an intervention is done or further invasive procedures such as amniocentesis or chorionic villus sampling are conducted to confirm the findings.

**Table 3:** Likelihood ratios of individual markers for trisomy 21\(^{21,22,23}\)

<table>
<thead>
<tr>
<th>Ultrasound parameter</th>
<th>Likelihood ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuchal fold</td>
<td>11-17</td>
</tr>
<tr>
<td>EIF</td>
<td>1.8-2.8</td>
</tr>
<tr>
<td>Short humerus</td>
<td>5.1-7.5</td>
</tr>
<tr>
<td>Short femur</td>
<td>1.5-2.7</td>
</tr>
<tr>
<td>Echogenic bowel</td>
<td>6.1-6.7</td>
</tr>
<tr>
<td>Pyelectasis</td>
<td>1.5-1.9</td>
</tr>
<tr>
<td>Structural anomaly</td>
<td>3.3</td>
</tr>
</tbody>
</table>

Revised risk = A priori risk X Likelihood ratio (LR)

Example - A women with a priori risk of 1/500 based on quad scan has a femur with pyelectasis.

Revised risk = 1/500 x 1.5 (LR of pyelectasis) = 1/333

**Central nervous system (CNS) and spine anomalies**

The central nervous system starts developing 5 weeks and most of the structures are formed by 12-15 weeks. The structures that are not formed by 15 weeks include corpus callosum, cerebellar vermis, cerebral sulci and

**Table 4:** Abnormal CNS findings and their significance

<table>
<thead>
<tr>
<th>Finding</th>
<th>Comments</th>
</tr>
</thead>
</table>
| Choroid plexus cysts     | 1. They are seen in up to 6% of normal euploid fetuses, usually noted between 14-26 weeks  
2. Most are of insignificant value  
3. There is a small risk of trisomy 18, hence other parameters such as advanced maternal age, NT and maternal serum markers should be taken into account before prognosticating the mother |
| Blakes cyst pouch        | It is a CSF filled pouch seen in the posterior fossa behind the cerebellar vermis and is a normal finding |
| Cavum veli interpositi  | 1. It is a midline cystic collection seen below the corpus callosum, behind the upper brainstem  
2. If the size is > 8 mm, then a detailed evaluation to look for other CNS anomaly is warranted  
3. Consider advising fetal MRI  
4. Differential diagnosis include vein of galen malformation, pineal gland cysts, cystic teratoma and bleed |
| Ventricleomegaly         | 1. Ventricleomegaly is the most common CNS abnormality detected prenatally (approximately 1/1000)\(^{24,25,26}\)  
2. Associated CNS anomalies include trisomies, Chiari II malformation with or without spina bifida, aqueduct stenosis, Dandy walker malformation, corpus callosum agenesis, migration anomalies  
3. Measurement is taken transversely at the atrium of occipital horn |
Finding | Comments
---|---
4. Beyond the first trimester, a cut off of 10 mm is taken as abnormal; Mild -10-12 mm, moderate 12-15mm, severe >15mm
5. Further investigations - Detailed ultrasound scan for other anomalies including spina bifida, Karyotyping, TORCH profile, maternal antibodies for Neonatal alloimmune thrombocytopenia (NAIT), 3D ultrasound and MRI scan
6. Prognosis - Depends on if any additional anomalies are there and in isolated cases the size. In isolated mild ventriculomegaly approximately 90% of the fetuses have a normal near developmental outcome where as in severe ventriculomegaly only around 30% of the fetuses have a normal outcome

Spina bifida
1. May be open or closed
2. Further investigations: Family history, Maternal serum AFP (MSAFP) (Might be normal in closed defects); Ultrasonography of head to look for signs of chair II malformation - Ventriculomegaly, Lemon sign (bifrontal bone scalloping); Banana sign (herniation of cerebellar tonsils)

Corpus callosum agenesis
1. Absent corpus callosum is usually associated with additional CNS defects in about 80% of cases (Example Dandy-Walker malformation, migration defects). Malformations of cardiovascular and urinary tract are also seen in high frequencies.
2. Its visualisation is possible beyond 15 weeks, but at times can be difficult. Absent cavum septum pellucidi is an indirect marker of corpus callosum agenesis and can be seen as early as 17 weeks
3. Further investigations : Detailed 2D scan, 3D scan, MRI, TORCH profile and karyotyping
4. Prognosis: Poor if other anomalies are present. Fetuses with isolated finding may have a good prognosis.

Calcifications
Is associated with TORCH infections (CMV, Toxoplasmosis), bleed, Sturge Weber syndrome, Tuberous sclerosis

Vein of Galen malformation
Seen as an dilated structure behind the thalamus and is the most common vascular CNS anomaly that is detected antenatally

Intracranial bleed
Suspect maternal trauma, anticoagulant drug intake, cocaine abuse, NAIT, fetal infections, death of a co-twin in monochorionic twinning. Might resolve or develop into hydrocephalus, porencephaly or clefts

| Table 5: Abnormal Lung Anomalies and their importance |
|----------|-----------------------------------------------|
| Anomaly | Salient features |
| Pulmonary hypoplasia | 1. The common techniques and parameters used for diagnosing pulmonary hypoplasia are lung volume estimation (3D Ultrasound, MRI), Lung: Head ratio, Lung: body weight ratio and doppler studies of pulmonary arteries
2. In cases of unilateral pulmonary hypoplasia, mediastinal shift towards the same side occurs. The other lung undergoes compensatory hyperplasia. The other lung has to be carefully examined to rule out CCAM, CDH, CLE, pleural effusion etc. |
| CCAM | 1. It is due to an insult in the embryonic stage of lung development (before 7 weeks); can be diagnosed as early as 16 weeks; Classified into 3 types<sup>27</sup>
2. The size predicts the prognosis.
3. Follow up : Follow up weekly to look for the development of hydrops
4. Treatment: If hydrops develops, then interventions such as single stick procedure or shunt placement is indicated. MRI might be helpful in delineating the anatomy prior to the intervention. Other anomalies of cardiac, renal and gastrointestinal should be looked for.
5. Prognosis: If there is no hydrops prior to 26 weeks, then the prognosis is good<sup>28,29</sup>. Many of the CCAM regress spontaneously, though may not disappear completely. Postnatally upto 40% of the neonates can be symptomatic<sup>10</sup>. Chest X Ray might miss the diagnosis. Postnatally all CCAMs are resected due to feared complications of infection and carcinomatous change |
| Broncho-pulmonary sequestration | 1. Is divided into intralobar (usually located in the left lower lobe of lung) and extralobar (Usually located in the left posterior costodiaphragmatic sulcus or may be present below the diaphragm and can be mistaken for renal or adrenal masses). Both are supplied by systemic arteries. While in intralobar sequestration the venous drainage is through vena cava/ azygos/ hemiazygous vein; in case of extralobar it is through pulmonary veins
2. Sequestrations never have cysts unless concomitant CCAM is present
3. Doppler ultrasound can show the systemic feeding artery which usually has its origin from the abdominal or thoracic aorta
4. Large sequestrations might be associated with pleural effusion which necessitates drainage via a pleuroamniotic shunt |
gyri and myelination. The cerebral sulci and gyri can develop a characteristic pattern by 18 weeks; corpus callosum is usually formed by 20 weeks and cerebellar vermis by 22 weeks. Myelination starts at 30 weeks. At birth in a term baby only the posterior brainstem, cerebellar peduncles and posterior limb of the internal capsule are myelinated.

Lung anomalies
The most common anomalies encountered are pulmonary hypoplasia, congenital cystic adenomatoid malformation (CCAM), bronchopulmonary sequestration, congenital diaphragmatic hernias (CDH), congenital lobar emphysema (CLE). CCAM, CLE and sequestration are commonly referred to as Congenital pulmonary airway malformation (CPAM) spectrum. Important lung anomalies seen on ultrasound are summarized in Table 5.

Heart anomalies
Congenital heart disease is a significant problem encountered by a neonatologist. Most of the congenital heart disease (CHD) is multifactorial in inheritance. The risk of CHD increases when a previous sibling is affected. The most common congenital heart disease is ventricular septal defect (VSD).

The neonatologist might ask for a fetal echocardiography in the following conditions-  
1. Suspected congenital heart disease in the screening ultrasound  
2. Hydrops fetalis  
3. Fetal arrhythmia - To look for structural lesions or to look for signs of hydrops  
4. Chromosomal anomalies/ Other congenital anomalies  
5. Family history of congenital heart disease  
6. Certain maternal conditions (Diabetes mellitus, SLE, phenylketonuria)  
7. Drug exposure (E.g. Phenytoin, lithium etc)  

Common cardiac anomalies encountered on antenatal ultrasound have been summarized in Table 6. Gastrointestinal anomalies: Commonly encountered gastrointestinal anomalies have been summarized in table 7.
### Table 6: Congenital heart diseases

<table>
<thead>
<tr>
<th>CHD</th>
<th>Comments</th>
</tr>
</thead>
</table>
| Ventricular Septal Defect (VSD)                                     | 1. Small VSDs may be missed in utero\(^{33,34}\); doppler might be helpful in detecting small VSDs  
2. They are associated with chromosomal anomalies, extra-cardiac and cardiac anomalies and they should be looked for |
| Atrio-ventricular septal defect; endocardial cushion defects (AVSD)  | 1. Like VSD, it is usually associated with cardiac, extra-cardiac and chromosomal anomalies  
2. Trisomy 21 is the most common aneuploidy associated with AVSD\(^{35}\)                                                      |
| Ebstein anomaly                                                     | 1. It can be easily diagnosed in-utero  
2. They are more prone for arrhythmias and hence hydrops fetalis                                                                            |
| Hypoplastic left heart syndrome (HLHS)                             | 1. Mitral atresia, aortic stenosis/ atresia and often coarctation of aorta are associated with this disorder  
2. It carries a very high mortality risk                                                                                                    |
| Total anomalous Pulmonary Venous Connection (TAPVC)                | 1. Diagnosis of TAPVC antenatally is very difficult  
2. The signs to look for are a small left atrium due to the defect in the drainage of the pulmonary veins, prominent right ventricle and pulmonary artery |
| Coarctation of aorta                                               | 1. Its diagnosis is difficult in fetal life  
2. Diagnosis is suspected when the left ventricle is smaller in size compared to the right ventricle; and when the ratio of ascending aorta to pulmonary artery is less than the normal \(^{36}\) |
| Premature ventricular/ atrial contractions                         | 1. They are benign and most of them disappear in utero  
2. A small percentage of them develop into arrhythmias                                                                               |
| Supraventricular tachycardia (SVT)                                 | 1. SVTs are usually diagnosed using M Mode  
2. SVTs have to be evaluated for structural anomalies  
3. Doppler is used to assess for tricuspid regurgitation which precedes hydrops  
4. Fetuses with tricuspid regurgitation or hydrops should be treated with maternal anti-arrhythmic drugs such as digoxin  
5. If there are no structural anomalies, then the prognosis is good                                                                 |
| Congenital heart block                                             | 1. Congenital heart block is associated with maternal SLE and with structural heart diseases  
2. These fetuses should be monitored for cardiac failure and hydrops                                                                     |

### Table 7: Gastrointestinal anomalies

<table>
<thead>
<tr>
<th>Anomaly</th>
<th>Comments</th>
</tr>
</thead>
</table>
| Absent stomach         | 1. Can be a normal finding. A complete 30 minute observation is required to see for filling of stomach  
2. Tracheo-esophageal atresias are associated with small or absent stomach  
3. Congenital diaphragmatic hernia might be associated with a stomach that has herniated into the chest  
4. All cases of absent stomach have to be evaluated for aneuploidy                                                                 |
| Echogenic bowel         | The following are the differential diagnosis for echogenic bowel -  
1. Cystic fibrosis  
2. Swallowed blood (eg. Antepartum haemorrhage)  
3. Trisomy 21  
4. Various gastro-intestinal atresias  
5. TORCH infections (CMV, Parvovirus)  
6. Intrauterine growth restriction  
7. Fetal death                                                             |
| Duodenal atresia       | 1. It is usually diagnosed late in the 2nd trimester  
2. Findings of double bubble sign with polyhydramnios is very suggestive of duodenal atresia  
3. Evaluation for trisomy 21 should be done in all cases                                                                   |
| Gastrochisis           | 1. Suspected when free floating bowel loops are present in the amniotic cavity  
2. It is associated with other GI anomalies such as atresia, but not with other system anomalies  
3. Even though the risk of aneuploidy is low, it is higher than that in the general population                                 |
| Omphalocele            | 1. In contrast to gastrochisis, omphalocele is associated with other system anomalies  
2. In the first trimester, normal bowel herniation is present which should not be mistaken for omphalocele. But however, if liver is present in the herniated contents, then it is highly suggestive of omphalocele.  
3. Detailed work up for other system defects and genetic counselling should be done                                          |
Table 8: Common genitourinary abnormalities

<table>
<thead>
<tr>
<th>Anomaly</th>
<th>Comments</th>
</tr>
</thead>
</table>
| Bilateral renal agenesis         | 1. Amniotic fluid volume is not dependant on fetal urine till about 16 weeks gestation, so oligohydramnios might not be a specific sign  
2. Failure to visualize the bladder might be an indirect sign of renal agenesis  
3. In cases of oligohydramnios, doppler evaluation of renal arteries might be useful to diagnose renal agencies  
4. MRI might be helpful in cases of oligohydramnios were the ultrasonography might be difficult |
| Unilateral renal agenesis        | 1. It might be associated with contra lateral compensatory hypertrophy of the kidney  
2. This compensatory hypertrophy should be differentiated from vesico-ureteral reflux (VUR), which is also common in unilateral renal agenesis  
3. Other system anomalies such as that of GI and cardiac should be ruled out |
| Ectopic kidney                   | 1. Ectopic kidney is associated with other system anomalies and VUR                                                                                                                                 |
| Multi cystic kidney disease (MCKD) | 1. Bilateral MCKD is lethal  
2. Unilateral MCKD associated with contralateral renal agenesis is also uniformly fatal  
3. Unilateral MCKD otherwise is associated with contralateral Uretero-pelvic junction obstruction  
4. MCKD must be differentiated from hydronephrosis due to uretero pelvic junction obstruction or obstructive cystic renal dysplasia. Obstructive cystic dysplasia is usually due to urethral obstruction and hence is bilateral, were as MCKD is frequently unilateral. Also, normal intervening parenchymal tissue can be appreciated in obstructive cystic dysplasia, but not in MCKD |
| Autosomal recessive polycystic kidney disease (ARPKD) and autosomal dominant polycystic kidney disease (ADPKD) | 1. ARPKD is not evident in antenatal scan until 26 weeks gestation, hence a normal scan early in the gestation cannot be confirmative  
2. ADPKD is rarely diagnosed antenatally as the changes are not present at this time |
| Hyperechogenic kidneys           | The differential diagnosis of hyperechogenic kidneys include -  
1. Normal variant  
2. Obstructive dysplasia  
3. ADPKD  
4. ARPKD  
5. Syndromes - Trisomy 13, Beckwith-Wiedmann Syndrome, Perlman syndrome, Meckel Gruber Syndrome  
6. Congenital nephrosis  
7. Renal tumors  
8. Renal vein thrombosis  
9. CMV infection |
| Hydronephrosis                   | 1. The Society For Fetal Urology Grading system is used to classify hydronephrosis into 5 grades - Grade 0-4  
2. The anteroposterior diameter of the renal pelvis (RPD) is also used to grade hydronephrosis. RPD of >/= 5mm in the mid second trimester and >/= 7 mm in the third trimester is used as cut offs to define hydronephrosis. RPD of >10 mm in the second trimester and > 15 mm in the third trimester is used to define severe hydronephrosis  
3. Most of the mild hydronephrosis are transient and resolve spontaneously. Severe hydronephrosis is usually associated with significant underlying obstruction and most likely need surgical intervention post-natally  
4. The most common cause of hydronephrosis is Uretero-pelvic junction obstruction, followed by vesico-ureteral reflux and posterior urethral valve  
5. Evaluation of a fetus with hydronephrosis should include follow up and looking for oligohydramnios and increasing size of hydronephrosis  
6. Based on the prognosis of the underlying disorder, vesico-amniotic shunt can be considered in selective cases |
Genito-urinary anomalies:
The kidneys and the bladder are normally visualized by the end of the first trimester. The fetal urine production rises from about 5 ml/ hour at 20 weeks to 50 ml/hour at 40 weeks.\(^{25,37}\)

The antenatal assessment of the genito urinary tract involves the following components -

1. Amniotic fluid volume: Oligo hydramnios in the absence of rupture of membranes, maternal drugs or fetal IUGR, especially in the early 2nd trimester is a bad prognostic sign.

2. Looking for the structural abnormality in the genitourinary system which includes -
   - Bladder - Presence and its size
   - Kidneys - Number, position, echogenicity, size
   - Collecting system - Dilation, level of obstruction, whether unilateral or bilateral
   - Fetal sex

3. Assessment for other system anomalies
   Common genitourinary anomalies seen on antenatal ultrasound have been summarized in Table 8.

Conclusion
Obstetric ultrasound is a vast topic, covering various aspects of fetal, maternal and placental physiology. It is pertinent for a Neonatologist to be aware of the common fetal conditions for which expert opinion is often sought for. The aspects of obstetric ultrasound that are not covered in this article include fetal hydrops and IUGR. These are conditions that are commonly encountered and most of the Neonatologist should be abreast of the recent advances in these topics. The optimum management of a high risk neonate starts in fetal life and for this a close collaboration between the Neonatologist, Obstetrician and the Radiologist is vital.

References


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**Training workshop of NICU Staff on Data Base**

NNF in support with UNICEF organized two training workshops of NICU Staff on Database held on 09th & 10th July, 2016 at Hotel Radisson Blu, Dwarka, New Delhi.
Acute Arterial Ischemia in a Neonate: Complication of an indwelling radial artery catheter

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1Department of Pediatrics, Shree Krishna Hospital, Pramukhswami Medical College, Karamsad, Dist: Anand, Gujarat, India. Pin-388325

Abstract

Full term newborn was admitted at 70 hours of life having perinatal depression, meconium stained liquor, shock and hypoglycemic seizures. He was ventilated, received antibiotics and vasopressors. After 8 hours of left radial artery catheterization, ischemic changes appeared on tips of all the fingers. Catheter was removed and intravenous unfractionated heparin was started. Arterial Doppler revealed thrombus in both radial and ulnar arteries. The case was of category III (irreversible) acute arterial ischemia. Review Doppler after 4 days showed low resistance and dampened flow in radial and ulnar arteries. Surgical intervention was not done. Aspirin was given at discharge and, at 40 days of life distal end of the metacarpals were affected. Positive modified Allen test and close clinical monitoring did not guarantee safety of radial artery catheterization. Other measures need to be critically evaluated to identify evolving thrombus early.

Keywords: Gangrene, Newborn, Thrombus, Ultrasound, Vascular

Introduction

Indwelling arterial catheters (IACs) are commonly used in Neonatal Intensive Care Units (NICU). Umbilical and radial arteries are the most preferred peripheral route and femoral arteries as central source. Increased incidence of arterial thrombosis was seen in femoral catheters as compared to radial artery catheters. Radial artery site is recommended as safe for catheterization in all age groups of children1. In this case, we highlight acute arterial ischemia in a newborn following a radial arterial catheterization.

Case Report

The full term 3.0 kg male newborn was born by spontaneous vaginal delivery. Antenatal history was uneventful. The liquor was meconium-stained and newborn had weak cry after stimulation. He did not breast feed well, had poor sucking and poor activity for 46 hours before admission. He developed staring look and tonic posturing on third day of life and was referred to this hospital at 70 hours of life. He had normal axillary temperature (99°F), tachycardia (192/min), weak peripheral pulses, respiratory distress, hypoglycemia (blood sugar: 24 mg/dl). capillary refill time of 3 second, lethargy and pulse-oximetry reading of 84% on air, at the time of admission. He received bolus of 10% dextrose and normal saline, was mechanically ventilated. He received inotropes, maintenance fluids, antibiotics and Phenobarbitone.

Left radial artery catheterization was performed with 24 gauge catheter after evaluating the ulnar artery flow by modified Allen test. Continuous unfractionated heparin (UFH) infusion of 0.5units/ml/h was started through arterial line2. After 8 hour of insertion; early ischemic changes developed over tips of the fingers. The catheter was removed. Left brachial artery pulsations were palpable, but ulnar and radial artery pulsations were not felt. Intravenous UFH bolus (75 units/Kg) followed by continuous infusion (28 units/Kg/h) was started after consultation with vascular surgeon while monitoring activated partial thromboplastin time (aPTT)3.4. His investigations are shown in Table 1. Cerebro-Spinal Fluid analysis was normal and blood culture revealed no growth.

An arterial Color Doppler reported non-visualization of normal anechoic lumen of radial and ulnar arteries in the left forearm and wrist due to extensive thrombus involving both arteries. Both arteries showed no color flow on power Doppler or spectral waveforms suggesting complete thrombotic occlusion.

The ischemia progressed to wrist at 48 hours (Figure 1) and after that circulation over dorsum of the hand...
improved, and hence UFH was continued and the decision to amputate was deferred to save the limb as maximum as possible. A repeat Color Doppler after 4 days reported sluggish flow in the proximal portion of radial and ulnar arteries along with a biphasic waveform, which was consistent with post-stenotic dilation due to dissolving thrombus. However the distal portion near the left wrist still did not show any flow. Flow in the left brachial artery was normal.

On day 6 of admission, he was weaned off from mechanical ventilator. On 12th day third arterial color Doppler revealed anechoic lumen in terminal part of left brachial, radial and ulnar arteries with no evidence of thrombus or stenosis. Both radial and ulnar arteries showed low resistance and dampened flow, with no definite evidence of thrombus, stenosis or occlusion. UFH was stopped on 12th day. On follow up at 40 days of life gangrenous area involved distal portion of the metacarpals (Figure 2).

Informed consent was taken from the parent of this child for publication. Institutional Human Research Ethics Committee of H M Patel Center for Medical Care and Education approved this report.

Discussion

Vessel catheterization is a major cause of thrombosis in neonates. No thrombotic events were reported in 418 radial artery catheterizations while incidence of thrombotic events was 13% (18 of 137) in femoral route in a study by Brotschi B et al suggesting the radial artery to be comparatively safer for IAC placement1.

In the current case, the extent of acute limb ischemia was of category III (irreversible) as per the classification developed by Rutherford et al and revascularization is usually futile, and primary amputation should be considered [8]. Thrombolysis has a higher incidence of ongoing limb ischemia and should be weighed against individual risk factors of surgery9.

We did not evaluate the complete thrombotic profile in this case as there was no evidence of familial prothrombotic disorder. Although neonatal period itself is a risk factor for developing thrombo-embolism, shock and presence of radial artery catheter were the major risk factors for developing thrombus in this case.

Table 1: Laboratory investigations

<table>
<thead>
<tr>
<th>Investigation</th>
<th>Admission</th>
<th>24 h</th>
<th>12 d</th>
</tr>
</thead>
<tbody>
<tr>
<td>S Sodium (mmol/L)</td>
<td>152</td>
<td>153</td>
<td>---</td>
</tr>
<tr>
<td>S Potassium (mmol/L)</td>
<td>6.2</td>
<td>4.1</td>
<td>---</td>
</tr>
<tr>
<td>S Ionized Calcium (mmol/L)</td>
<td>1.3</td>
<td>1.48</td>
<td>---</td>
</tr>
<tr>
<td>C – Reactive Protein (mg/L)</td>
<td>47.3</td>
<td>24.1</td>
<td>8</td>
</tr>
<tr>
<td>S TSH (mU/L)</td>
<td>9.2</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>S Total Bilirubin (mg/dl)</td>
<td>13.4</td>
<td>12.8</td>
<td>---</td>
</tr>
<tr>
<td>S Indirect Bilirubin (mg/dl)</td>
<td>12.1</td>
<td>10.4</td>
<td>---</td>
</tr>
<tr>
<td>S Creatinine (mg/dl)</td>
<td>1.9</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>Total Leukocyte Count/μl</td>
<td>6900</td>
<td>3400</td>
<td>11900</td>
</tr>
<tr>
<td>Haematocrit (%)</td>
<td>45.6</td>
<td>47.6</td>
<td>33.9</td>
</tr>
<tr>
<td>Platelet/μl</td>
<td>338000</td>
<td>201000</td>
<td>946000</td>
</tr>
<tr>
<td>Band Cells (%)</td>
<td>0.06</td>
<td>0.04</td>
<td>0.05</td>
</tr>
<tr>
<td>Toxic Granules</td>
<td>Present</td>
<td>Absent</td>
<td>Absent</td>
</tr>
<tr>
<td>Absolute Neutrophil Count/μl</td>
<td>1587</td>
<td>408</td>
<td>1666</td>
</tr>
<tr>
<td>PT INR (sec)</td>
<td>1.56</td>
<td>1.45</td>
<td>0.85</td>
</tr>
<tr>
<td>aPTT (sec)</td>
<td>42.7</td>
<td>89.1</td>
<td>43.9</td>
</tr>
<tr>
<td>pH</td>
<td>7.34</td>
<td>7.31</td>
<td>---</td>
</tr>
<tr>
<td>PCO₂ (mmHg)</td>
<td>10</td>
<td>32</td>
<td>---</td>
</tr>
<tr>
<td>PO₂ (mmHg), FiO₂(%)</td>
<td>169, 0.4</td>
<td>76, 0.21</td>
<td>---</td>
</tr>
<tr>
<td>HCO₃ act (mEq/L)</td>
<td>5.4</td>
<td>16.1</td>
<td>---</td>
</tr>
<tr>
<td>BE ecf (mEq/L)</td>
<td>-20.4</td>
<td>-10.2</td>
<td>---</td>
</tr>
</tbody>
</table>

References


The 36th Annual Convention of National Neonatology Forum (NEOCON 2016) is scheduled to be held on 8th to 11th December, 2016 at Indore, M.P. All States and City Branch of NNF are requested to send their activity report latest by 25th October, 2016. Also are branches are requested to send the activity report of Breast feeding program conducted in their Branch during the year 2016.

Report of Newborn Week can be sent by 30th November, 2016.
Introduction
The power of first impression is well known. None may be more significant than the first experience of a newborn baby exiting mother’s womb. Because the first hour after birth is so momentous, we have named it “The Sacred Hour“ shows the importance of early breastfeeding. Nutrition during infancy and early childhood not only determines growth but also impacts on the future adult health. It is essential that healthy eating habits are to be promoted from a very young age.

Initiation of breastfeeding is defined as the first time when the mother breastfeeds the baby after delivery. In the half hour after birth, the baby’s sucking reflex is the strongest and the baby is more alert, so it is the ideal time to start breastfeeding. Skin-to-skin contact improves physiologic stability for both mother and baby in the vulnerable period immediately after birth. It increases maternal attachment behaviour, protects against the negative effects of maternal-infant separation and supports optimal infant brain development. It promotes initiation of the first breastfeeding, resulting in increased breastfeeding initiation and duration rates.

In the developing world breastfeeding is strongly correlated to a reduction in infant mortality and morbidity i.e reduction in occurrence of Sudden infant death syndrome, Eczema, Juvenile onset diabetes, gastrointestinal, urinary and respiratory infections, enhanced neurodevelopment, protection from breast cancer and certain ovarian cancers. Increasing our understanding of barriers and reasons for not

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Original Article

Time of Initiation of Breastfeeding in Various Modes of Delivery and To Observe the Effect of Low Birth Weight and Period of Gestation on Initiation of Breastfeeding

The Effect of Mode of Delivery, Low Birth Weight and Gestation on Initiation of Breast Feeding

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Department of Pediatrics, Government Medical College, Patiala (Pb.), India

Abstract

Background: According to the guidelines of BFHI-Early Initiation of breastfeeding is the most important step among ‘10 steps to successful breastfeeding’. There are certain factors influencing early initiation of breastfeeding, most of them can be corrected by paying attention and using certain strategies.

Aims & Objectives
1. To study the difference between the time of initiation of breastfeeding in vaginally delivered and LSCS born deliveries.
2. To evaluate the effect of low birth weight and period of gestation on initiation of breastfeeding.

Methods: This observational cross-sectional study was conducted on 400 newborn babies delivered at Rajindra Hospital, Patiala and admitted to Neonatology section of Department of Pediatrics, to compare the time of initiation of breastfeeding between various modes of delivery and to observe the effect of birth weight and period of gestation on initiation of breastfeeding. Results: Normal vaginally delivered babies were breastfed earlier when compared to caesarean section. Breastfeeding was started early in babies with birth weight >2500g when compared to babies with ≤2500g. Term babies were breastfed earlier. Conclusion: Caesarean section seems to be a major barrier to early breastfeeding initiation. Breastfeeding was initiated earlier in term babies and with birth weight of >2500g.

Keywords: Breastfeeding, Modes of Delivery, Birth Weight, Period of Gestation.
commencing early breastfeeding is important to improve strategies and conditions to overcome such barriers.5

Determinants of breastfeeding initiation
There are many independent determinants of the decision to breastfeed such as:

Maternal age, Parity of Mother, Prelacteal feeding
Others are:

Mode of delivery and anaesthesia
Adverse effects of anesthesia on mother–infant pairs, maternal discomfort and delayed onset of lactation are cited for the late initiation of breastfeeding in caesarean section deliveries.6

Birth weight of the baby
Low birth weight newborns had less likelihood of being breastfed within the first hour of birth. This could be due to poor sucking capacity or associated illness among the low birth weight infants.7

Period of gestation
The late preterm infant and mother experience a cascade of events, such as ineffective sucking at the breast leading to poor intake of milk volume.8 preterm infants were less likely to receive breast milk than term infants and the likelihood of receiving breast milk was lowest among the youngest preterm infants.9

Prelacteal feeding
Early initiation of breastfeeding in a newborn and avoiding prelacteal feeding is an important and crucial step towards the feeding practices.10

The present study was conducted to evaluate the difference between the time of initiation of breastfeeding in vaginally delivered and LSCS born babies and to observe the effect of low birth weight and period of gestation on initiation of breastfeeding and to study other social factors effecting it.

Aims and objectives
1. To study the difference between the time of initiation of breastfeeding in vaginally delivered and LSCS born deliveries.
2. To evaluate the effect of low birth weight and period of gestation on initiation of breastfeeding.

Material and methods
After obtaining permission from the Ethical Committee, a cross sectional observational study was conducted on 400 newborn babies delivered at Obstetrics and Gynaecological Department of Rajindra Hospital Patiala and admitted to Neonatology section of Department of Pediatrics, Rajindra Hospital, Patiala.

Newborn babies were divided into two groups.
- Group-I consisted of 200 newborn babies delivered vaginally,
- Group-II consisted of 200 newborn babies delivered by caesarean section.

An informed consent was taken from the mother.

Inclusion criteria
1. Babies born at or beyond 33 weeks of gestation.
2. Babies born with birth weight 2000g and more and handed over to mother with satisfactory conditions.

Exclusion criteria
1. Babies who were sick and admitted to NICU for different conditions like Birth Asphyxia, with Respiratory Distress and other conditions.
2. Babies born with period of gestation less than 33 weeks and with birth weight less than 2000g.
3. Babies of HIV positive mothers.
4. Babies of mothers having Pregnancy induced hypertension (PIH) and on MgSo4 treatment.
5. Babies of mothers who were on treatment with cytotoxic drugs and on anti-thyroid drugs.

Gestational age was calculated from the first date of LMP to the date of delivery. It was compared to new Ballard’s Scoring System (1991). Discrepancy of +/- 2 weeks was considered as normal.11

Babies were classified as PRETERM (36 Weeks), TERM (37-41 Weeks), POSTTERM (>=42 Weeks) according to period of Gestation.12

New borns were classified as LOW BIRTH WEIGHT when the birth weight ≤ 2500g.12

The birth weight of neonate was recorded on electronic weighing machine manufactured by Smart care baby weighing machine with increment/decrement of 5gm. The birth weight was recorded immediately at birth after stabilization of newborn.

Babies were classified as AGA (10th-90th persentile), SGA (<10th persentile), LGA (>90th persentile) according to birth weight appropriate for that particular age of gestation.13

Details of mothers including risk factors, parity (multipara/primipara), mode of delivery (caesarean/vaginal), whether anesthesia during delivery given or not, address (urban/rural) etc were noted. Age of the mother was noted and categorized into 4 groups as age group 19-23 years, 24-28 years, 29-33 years and 34-38 years.
A questionnaire prepared to enquire about mother’s belief and knowledge about breastfeeding included following questions:
1. Whether colostrum should be given or not.
2. Whether mother has knowledge about duration of exclusive breastfeeding or not.
3. Whether prelacteal feed should be given or not.

Details of newborn including date and time of birth, sex of the baby (male/female), the time of initiation of breastfeeding and whether prelacteal feed was given to baby or not were collected.

**Statistical analysis**
Qualitative variables were compared using Pearson Chi-square test. ‘p’ value <0.05 was considered as significant.

**Observations**
A total of 400 newborn babies were subjected to the study and were divided into two groups each based on mode of delivery (I and II). Both the groups were studied for their effect on initiation of breastfeeding along with the effect of low birth weight and period of gestation.

During study special consideration was given to other determinants of initiation of breastfeeding to promote the early initiation and the following observations were made.

Table 1: distribution of cases according to mother’s age.

<table>
<thead>
<tr>
<th>Age of Mother (in years)</th>
<th>Group-I (Vaginal)</th>
<th>Group-II (Caesarean)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. %age</td>
<td>No. %age</td>
<td>No. %age</td>
<td></td>
</tr>
<tr>
<td>19-23 18.75%</td>
<td>75 18.75%</td>
<td>67 16.75%</td>
<td>142 35.5%</td>
</tr>
<tr>
<td>24-28 22.75%</td>
<td>91 22.75%</td>
<td>92 23.0%</td>
<td>183 45.75%</td>
</tr>
<tr>
<td>29-33 6.75%</td>
<td>27 6.75%</td>
<td>33 8.25%</td>
<td>60 15%</td>
</tr>
<tr>
<td>34-38 1.75%</td>
<td>7 1.75%</td>
<td>8 2%</td>
<td>15 3.75%</td>
</tr>
<tr>
<td>Total 200 50%</td>
<td>200 50%</td>
<td>200 50%</td>
<td>400 100%</td>
</tr>
</tbody>
</table>

Data related to mother’s age according to type of delivery was comparable in both the groups.

Table 2: Distribution of cases according to birth weight of baby.

<table>
<thead>
<tr>
<th>Birth Weight of baby (in gms)</th>
<th>Group-I (Vaginal)</th>
<th>Group-II (Caesarean)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. %age</td>
<td>No. %age</td>
<td>No. %age</td>
<td></td>
</tr>
<tr>
<td>≤2500 52 13%</td>
<td>45 11.25%</td>
<td>97 24.25%</td>
<td></td>
</tr>
<tr>
<td>&gt;2500 148 37%</td>
<td>155 38.75%</td>
<td>303 75.75%</td>
<td></td>
</tr>
<tr>
<td>Total 200 50%</td>
<td>200 50%</td>
<td>400 100%</td>
<td></td>
</tr>
</tbody>
</table>

Out of total 400 (100%) babies, 97 (24.25%) were of birth weight ≤2500g and 303 (75.75%) were having birth weight >2500g in both the groups. There were no significant variations between the two groups.

Table 3: Distribution of cases according to period of gestation.

<table>
<thead>
<tr>
<th>Period of Gestation (in weeks)</th>
<th>Group-I (Vaginal)</th>
<th>Group-II (Caesarean)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. %age</td>
<td>No. %age</td>
<td>No. %age</td>
<td></td>
</tr>
<tr>
<td>≤ 36 36 9%</td>
<td>30 7.5%</td>
<td>66 16.5%</td>
<td></td>
</tr>
<tr>
<td>37-41 161 40.25%</td>
<td>170 42.5%</td>
<td>331 82.75%</td>
<td></td>
</tr>
<tr>
<td>≥ 42 3 0.75%</td>
<td>0 0%</td>
<td>3 0.75%</td>
<td></td>
</tr>
<tr>
<td>Total 200 50%</td>
<td>200 50%</td>
<td>400 100%</td>
<td></td>
</tr>
</tbody>
</table>

Out of total 400 (100%) babies, 66 (16.5%) babies were preterm having period of gestation ≤36 weeks, 331 (82.75%) were term babies with period of gestation 37-41 weeks and 3 (0.75%) were post term babies with period of gestation ≥42 weeks in both the groups. There were no significant variations between the two groups.

Table 4: Comparison of initiation of breastfeeding With mode of delivery.

<table>
<thead>
<tr>
<th>Mode of Delivery</th>
<th>Time of Initiation of Breastfeeding (min-hrs)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vaginal (N=200)</td>
<td>0-1hr 66.5% No. 62 31% 5 2.5% 0 0%</td>
<td>0.001$</td>
</tr>
<tr>
<td>Caesarean (N=200)</td>
<td>12.5% 131 65.5% 29 14.5% 15 7.5%</td>
<td></td>
</tr>
</tbody>
</table>

Table shows that the effect of mode of delivery on initiation of breastfeeding was found to be significant.

The effect of low birth weight of baby on initiation of breastfeeding was found to be significant.
Table 5: Comparison of initiation of breastfeeding with birth weight of baby.

<table>
<thead>
<tr>
<th>Birth Weight of Baby</th>
<th>Time of Initiation of Breastfeeding (min-hrs) (group-I &amp; group-II)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0-1hr</td>
<td>1-4hr</td>
</tr>
<tr>
<td>≤2500g (N=97)</td>
<td>29</td>
<td>29.9%</td>
</tr>
<tr>
<td>&gt;2500g (N=303)</td>
<td>127</td>
<td>41.92%</td>
</tr>
</tbody>
</table>

Table 6: Comparison of initiation of breastfeeding with period of gestation.

<table>
<thead>
<tr>
<th>Period of gestation (in weeks)</th>
<th>Time of Initiation of Breastfeeding (min-hrs) (group-I &amp; group-II)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤36 (N=66)</td>
<td>0-1 hr</td>
<td>1-4hr</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>22.74%</td>
</tr>
<tr>
<td>37-41 (N=331)</td>
<td>139</td>
<td>42.01%</td>
</tr>
<tr>
<td>≥42 (N=3)</td>
<td>2</td>
<td>66.67%</td>
</tr>
</tbody>
</table>

The effect of period of gestation of baby on initiation of breastfeeding was found to be significant.

Table 7: Comparison of initiation of breastfeeding with mother’s age.

<table>
<thead>
<tr>
<th>Mother’s Age (in years)</th>
<th>Time of Initiation of Breastfeeding (min-hrs) (group-I &amp; group-II)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0-1hr</td>
<td>1-4hr</td>
</tr>
<tr>
<td>19-23 (N=142)</td>
<td>53</td>
<td>37.33%</td>
</tr>
<tr>
<td>24-28 (N=183)</td>
<td>69</td>
<td>37.7%</td>
</tr>
<tr>
<td>29-33 (N=60)</td>
<td>31</td>
<td>51.67%</td>
</tr>
<tr>
<td>34-38 (N=15)</td>
<td>5</td>
<td>33.34%</td>
</tr>
</tbody>
</table>

The data given above thus depicts that as the mother age advances, chances of early initiation also increases, age of 29-33 years as the most appropriate age for early initiation of breastfeeding. The difference between various age groups according to time of initiation of breastfeeding was found to be significant.

Table 8: Comparison of initiation of breastfeeding with parity of mother.

<table>
<thead>
<tr>
<th>Parity of mother</th>
<th>Time of Initiation of Breastfeeding (min-hrs) (group-I &amp; group-II)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0-1hr</td>
<td>1-4hr</td>
</tr>
<tr>
<td>Primipara (N=150)</td>
<td>49</td>
<td>32.67%</td>
</tr>
<tr>
<td>Multipara (N=250)</td>
<td>112</td>
<td>44.80%</td>
</tr>
</tbody>
</table>

Above data shows that multipara mothers were likely to initiate breastfeeding earlier than primipara mothers making the difference significant.

Table 9: Comparison of initiation of breastfeeding with prelacteal feed.

<table>
<thead>
<tr>
<th>Prelacteal Feed</th>
<th>Time of Initiation of Breastfeeding (min-hrs) (group-I &amp; group-II)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes (N=54)</td>
<td>5</td>
<td>9.26%</td>
</tr>
<tr>
<td>No (N=346)</td>
<td>153</td>
<td>44.23%</td>
</tr>
</tbody>
</table>

The data above thus showing the effect of prelacteal feed given immediately after birth on initiation of breastfeeding as significant one.

Discussion

This study was conducted on 400 newborn babies delivered at Obstetrics and Gynaecological Department of Rajindra Hospital Patiala and admitted to Neonatology section of Department of Pediatrics, Rajindra Hospital, Patiala.
Initiation of breastfeeding with mode of deliver
From our results caesarean section seems to be a major barrier to early breastfeeding initiation.

Our study was comparable to many studies done previously as done by Habib et al [14] (2003) and Wang et al [15] (2006) where delayed initiation was seen in caesarean deliveries. Similarly study done by Seid et al [16] (2014) showed similar results of early initiation in vaginal deliveries.

Initiation of breastfeeding with birth weight
In our study it was seen that most of the babies where birth weight was more i.e. >2500g, were able to initiate breastfeeding in first hour of birth as compared to babies with birth weight ≤2500g i.e. 41.92% and 29.9% respectively. Thus showing that initiation of breastfeeding in low birth weight babies was significantly delayed.


Initiation of breastfeeding with period of gestation
In this study, preterm infants had significantly lower rates of early breastfeeding than term infants. It was observed that babies born with period of gestation ≤36 weeks, only in 15 (22.74%) cases breastfeeding was initiated in 0-1 hour as compared to 139 (42.01%) cases in term babies (37-41 week) and 2 (66.67%) cases in post term babies (≥42 weeks) breastfeeding was initiated in 0-1 hour (because of very low number of babies in this group). Thus clearly showing the positive relation between higher gestation and early initiation of breastfeeding.

Our study was comparable to Ayton et al [8] (2012) where it showed negative association between prematurity and early initiation of breastfeeding. Similarly study conducted by Yadav et al [18] (2015) showed the positive association between term gestation and early initiation of breastfeeding.

Initiation of breastfeeding with mother’s age
Our study depicts the effect of mother’s age on initiation of breastfeeding was statistically significant.

Our study was comparable to studies conducted by Ekambaram et al [19] (2010) and Kamalarupan et al [20] (2013). Similarly study done by Esteves et al [21] (2014) showed that younger age of the mother delayed the initiation in baby. Whereas Mahanum et al [22] (2014), reported delayed initiation in age group of 26-30 years contrary to what was seen in our study.

Initiation of breastfeeding with parity of mother
Our results observed a positive association between multiparity and early initiation of breastfeeding.

Our study was comparable to studies conducted by El Gilany et al [23] (2012) and Pereira et al [17] (2013). Similarly study done by Yahya & Adebayo et al [24] (2013) support our study and found the negative association of primiparity with early initiation of breastfeeding. Study conducted by Mahanum AM et al [22] (2014) contrary to our results showed that primiparity was positively associated with early initiation of breastfeeding.

Initiation of breastfeeding with prelacteal feed
In present study, Negative effect of prelacteal feed on early initiation of breastfeeding was found to be highly significant. This study was comparable to study done by Liben et al [25] (2015) which showed the early initiation of breastfeeding where no prelacteal feed was given. Similarly study done by Yadav et al [18] (2015) showed delayed initiation where prelacteal feed was given to babies. Early initiation of breastfeeding in a newborn and avoiding prelacteal feeding is an important and crucial step toward the feeding practices to achieve a healthy future in the form of healthy children. So, in our study the initiation of exclusive breastfeeding was in 86.5%, which was encouraging.

Conclusion
Vaginal delivery, birth weight >2500 gm., term gestation, advanced mother’s age and multiparity are predictors of early initiation of breast feeding where as caesarean delivery, birth weight < 2500 gm. younger age of mother and primiparity result in delayed initiation of breast feeding

Reference


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Dr. Sunil K Mehendiratta
Secretary, NNF
Magnitude, pattern and outcome of Hepatobiliary dysfunction in neonatal sepsis; A prospective observational study

Sunita Goyal1, Gayatri Dhanger2, R K Gupta3, Kapil Garg3, Vidhyadhar Singh Nitar4

1Resident, 2Assistant Professor, 3Professor, Department of Pediatrics, 4Senior Resident, Department of Gastroenterology, SMS Medical College, Jaipur-302004, SMS Medical College, India

Abstract

Objectives: To determine the magnitude, pattern and outcome of hepato-biliary dysfunction in neonatal sepsis.

Design: Prospective type of observational study.

Setting: Tertiary care, Department of Paediatric medicine, SMS Medical College, Jaipur and attached hospitals.

Methods: 100 neonates with blood culture proven sepsis were recruited from NICUs attached with SMS Medical College. Liver function tests were done on 3rd day of sepsis. In those with hepato-biliary dysfunction (SGPT >50 IU/L and/or direct bilirubin > 20% of total with a minimum level of 2 mg/dl), liver function tests were repeated after 7 days and then fortnightly until they normalized.

Results: Acinetobacter sp. (gram negative) was the most common organism isolated in 20 % of subjects followed by coagulase negative staphylococcus (18%). Hepato-biliary dysfunction was seen in 49% of cases on initial investigation in the form of elevated SGPT (49%) and conjugated hyperbilirubinemia (20%). Hepato-biliary dysfunction persisted in 9 (18.3%) cases out of 49 cases on day 10. These 9 cases were followed after 2 weeks and hepato-biliary dysfunction resolved in all of these cases.

Conclusion: Hepato-biliary dysfunction is common in neonatal sepsis but it is usually early, transient and carries good prognosis.

Key Words: Hepato-biliary dysfunction, Liver function tests, Neonatal, Sepsis, Conjugated hyperbilirubinemia

Introduction

Neonatal sepsis contributes to neonatal mortality about 25% in developing countries1 and 0.52 million deaths in the world annually2. Gram-negative organisms are commonly responsible for sepsis in developing countries and are associated with multi organ dysfunction, resulting in high mortality and morbidity. Hepatobiliary dysfunction has been reported in more than two-thirds of preterm neonates experiencing Gram-negative septicaemia3.

Jaundice is one of the most common clinical conditions observed in neonates. Most cases of unconjugated hyperbilirubinemia involve non-pathological factors; whereas cholestatic jaundice usually occurs due to serious underlying pathological causes4,5. Some cases of cholestasis require immediate, specific medical or surgical treatment, so it is necessary to identify the cause. Infectious causes are usually first to be investigated.

Viral, bacterial, fungal and parasitic infections can cause neonatal cholestasis, but bacterial infections are the most common among them. Such infections deserve special attentions because neonates can present with cholestasis as a component of sepsis, and cholestasis may be the only clinical sign of infection.

It is important to distinguish cholestatic jaundice because of septicemia from those having obstructive, hereditary, or metabolic disorders, to plan further investigations and appropriate management, including referral to specialized centers. We could found very few studies about the course, pattern of abnormalities, and outcome of hepato-biliary dysfunction in septic neonates. The present study was conducted to determine the magnitude and outcome of hepato-biliary dysfunction in neonatal sepsis.

Methods

The study was conducted in department of Pediatric medicine, S M S Medical College Jaipur, Rajasthan from July 2014 to October 2015. Admitted neonates with clinical suspicion of sepsis and a positive sepsis screen were subjected to blood culture. Septic screen included
total leukocyte count (TLC), CRP (C-reactive protein), band forms and toxic granules on PBF (peripheral blood film). Positive septicemia criteria means TLC count <5000/cu mm with ANC (Absolute neutrophil count) < 2000/cu mm, positive CRP and band forms >20% of total neutrophil count. A positive septic screen means out of these 3, at least 2 should be positive6. All symptomatic newborns having a blood culture positive sepsis were included in the study after excluding with exclusion criteria. Neonates with congenital hepato-biliary malformations (i.e. choledochal cyst on USG), fungal sepsis, severe hypoxic ischaemic encephalopathy, facial dysmorphism (i.e. Down syndrome) and newborns on parenteral nutrition were excluded from our study.

Informed consent was obtained from the parents of the eligible participants. The study was approved by the institutional research board and college ethics committee.

Data collection and case management
A thorough history about maternal fever, diarrhea, vomiting, leaking or bleeding per vaginum, multiple per vaginum examinations, difficult or prolonged labour, meconium aspiration and history of consanguineous marriage or family history of jaundice/cholestasis/liver disease was taken. Details on the mode of delivery and resuscitation at birth were recorded. Gestational age was calculated from the first day of the last menstrual period. If last menstrual period was not known, gestational age was calculated by modified Ballard score7.

Symptoms such as dullness, poor feeding, vomiting, pre-feed gastric residues, abdominal distension, respiratory distress, fever, hypothermia, apnea, bleeding, seizures etc. that suggest infection were also recorded.

A septic screen was done in all those with clinical suspicion of sepsis. Blood culture sensitivity was done in all with positive septic screens. Liver function tests were done on 3rd day of sepsis. Liver function tests included SGOT, SGPT, serum bilirubin (total, direct and indirect), serum total protein, serum albumin, serum alkaline phosphatase and PT/INR. In those with hepato-biliary dysfunction, liver function tests were repeated on 10th day and then fortnightly until they normalized. Hepato-biliary dysfunction was defined as SGPT > 50IU/L and/or direct bilirubin >20% of total bilirubin if total bilirubin >5mg/dl or > 1 mg/dl direct bilirubin if, total serum bilirubin is <5 mg/dl8.

A total of 0.5-1 ml of venous blood was collected in the blood culture bottle for bacterial culture. Then, it was incubated at 37 degree centigrade for 24 hour aerobically. After 24 hour primary subculture on Macconkey and blood agar was done. Growth positives were identified by colony morphology, gram staining and biochemical reactions.

USG abdomen was done to exclude congenital anomalies and to look for hepatic involvement in hepato-biliary dysfunction.

Meanwhile, neonates were started on intravenous antibiotics and other appropriate supportive management as soon as the sepsis was suspected on the basis of clinical signs and symptoms or a positive sepsis screen. The first line antibiotics were a combination of cefotaxim and amikacin. Antibiotics were revised as per blood culture and sensitivity report later. Antibiotics duration was 14 days in case of sepsis without meningitis and 21 days in case of meningitis.

Children having cholestatic jaundice were prescribed multivitamin supplementation initially in intravenous form and orally once they improved clinically. Oral supplementation consisted of vitamin A 25,000 IU given on alternate days, cholecalciferol 6000 IU/day, vitamin E 100 IU/day. Vitamin K 2.5 mg (intravenously or intramuscularly) was given weekly. This treatment was continued until liver function tests normalized.

Monitoring and follow up
Subjects were monitored for clinical improvement. Biochemical monitoring of liver function tests was done as mentioned above. The babies were discharged when they improved clinically, feeding well established and antibiotics course completed. Discharged babies having abnormal liver function tests were followed up on outdoor basis for clinical and biochemical improvements every fortnightly until liver function tests normalized.

Sample size estimation and statistical analysis
Calculated sample size was 100 subjects at absolute allowable error 10% and 95% confidence limit, assuming the proportion of 54.2%. The total sample size for this study was 110 patients. Out of 110, 10 subjects were lost to follow up.

The data were recorded in preformed proforma and then entered in Microsoft Excel sheet. The qualitative data were expressed in percentage and proportion and the quantitative data were expressed in mean and standard deviation. The qualitative data were analyzed using chi-square test and the quantitative data were analyzed using students’t’ test. The level of significance was taken as significant p value <0.05.

Results
During the study period, a total of 110 cases were taken. Out of them 10 were lost on follow up. So, results were obtained from 100 subjects. Mean age of the study population at enrollment was 4.2 ± 0.52 live days (range 1-21 live days). Mean birth weight in
our study was 2.02 ± 0.059 kg (range 0.75 kg-3.5 kg). Out of total 100 subjects, male and female were 71 and 29 respectively and male: female ratio was 2.44: 1. Preterm and full term cases were 63% and 37% respectively (Table 1).

Table 1: Characteristics of cases in the study.

<table>
<thead>
<tr>
<th></th>
<th>No. or % of cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male/Female</td>
<td>71/29</td>
</tr>
<tr>
<td>Preterm/full term</td>
<td>63/37</td>
</tr>
<tr>
<td>Early onset sepsis/Late onset sepsis</td>
<td>80/20</td>
</tr>
<tr>
<td>Gram positive/Gram negative cases</td>
<td>35/65</td>
</tr>
</tbody>
</table>

On blood culture Acinetobacter sp. (gram negative) was the most common organism (20%). Other gram negative organisms isolated were Enterobacter aerogenes (15%), Burkholderia (9%), Pseudomonas aerogenes (9%), Enterobacter cloacae (5%), Klebsiella (4%) and Escherichia coli (3%). Gram positive organisms in our study were Coagulase negative staphylococcus (18%), Coagulase positive staphylococcus (9%), Enterococcus (7%) and Coagulase positive Staphylococcus and Streptococcus combined (1%). Hepato-biliary dysfunction was seen in 49% of cases at admission/3rd day of sepsis. Liver function tests were repeated in these 49 cases after 7-10 days of initial investigations and at that time hepato-biliary dysfunction persisted in 18.37% (9 out of 49) of cases. These 9 cases were followed up after 14 days and at that time hepato-biliary dysfunction resolved in all of them.

Table 2: Various patterns and no. of cases of hepato-biliary dysfunction on initial work and on follow up.

<table>
<thead>
<tr>
<th></th>
<th>3rd day of sepsis</th>
<th>10th day</th>
<th>On next follow up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elevated SGPT</td>
<td>49/100</td>
<td>9/49</td>
<td>0/9</td>
</tr>
<tr>
<td>Conjugated hyperbilirubinemia (with Elevated SGPT)</td>
<td>20/100</td>
<td>0/20</td>
<td>-</td>
</tr>
<tr>
<td>Elevated alkaline phosphatase (with elevated SGPT)</td>
<td>2/100</td>
<td>0/2</td>
<td>-</td>
</tr>
<tr>
<td>Isolated conjugated hyperbilirubinemia</td>
<td>0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Isolated elevated alkaline phosphatase</td>
<td>0</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Mean ± standard deviation of serum bilirubin total, indirect and direct were 11.15± 4.53, 7.57± 3.13 and 3.58± 1.40mg/dl respectively in those with hepato-biliary dysfunction at admission/ 3rd day of sepsis. While in those not having hepato-biliary dysfunction mean ± standard deviation of serum bilirubin total, indirect and direct were 6.88 ± 4.26, 6.25± 4.134 and 0.634 ± 0.37 mg/dl respectively at admission/3rd day of sepsis. The difference was statistically significant in case of total (p value < 0.0001) and direct bilirubin levels (p value < 0.0001) and insignificant in case of indirect bilirubin levels (p value 0.0758).

In our study, there was not any significant difference in hepato-biliary dysfunction between male and female; gram positive and gram negative; full-term and preterm and early onset sepsis and late onset sepsis cases (Table 3).

Table 3: Comparison of hepato-biliary dysfunction in various scenarios

<table>
<thead>
<tr>
<th></th>
<th>No. (% ) of cases with hepato-biliary dysfunction</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male(71) v/s female(29)</td>
<td>34(47.88%) v/s 15(51.72%)</td>
<td>&gt; 0.05 (not significant)</td>
</tr>
<tr>
<td>Preterm(63) v/s fullterm(37)</td>
<td>28(44.44%) v/s 21(56.75%)</td>
<td>&gt; 0.05 (not significant)</td>
</tr>
<tr>
<td>Gram positive(35) v/s Gram negative(65)</td>
<td>14(40%) v/s 35 (53.8%)</td>
<td>&gt; 0.05 (not significant)</td>
</tr>
<tr>
<td>Early onset sepsis (80) v/s Late onset sepsis (20)</td>
<td>38(47.5%) v/s 11 (55%)</td>
<td>&gt; 0.05 (not significant)</td>
</tr>
</tbody>
</table>

Discussion

Systemic infections can lead to biochemical changes indicative of hepatic involvement especially in neonates. For the most part, hepatic involvement is overlooked or recognized as an inconsequential component of an identified systemic illness. In case of viral infections, misconstruing the illness as hepatic rather than systemic would not affect therapy significantly but bacterial infection as a cause of jaundice if overlooked would fail to receive appropriate therapy.9

According to this study hepato-biliary dysfunction is commonly seen during early part of sepsis and transient. Hepatic enzyme abnormalities (49%) were more common as compared to cholestatic jaundice (20%). This suggests that hepatocellular damage is more as compared to cholestatic effect. In a study conducted by Khalil et al10, hepato-biliary dysfunction in the form of either cholestatic jaundice or raised SGPT was seen in 54.2% of cases while cholestatic jaundice alone, raised SGPT alone and both cholestatic jaundice and raised SGPT were seen in 42.5%, 37.3% and 25.4% of cases respectively.
Microbial aetiology spectrum of neonatal sepsis differs in each hospital. Acinetobacter sp (20%) was the most common bacteria isolated followed by Enterobacter aerogenes (15%) in this study. Our result were similar with reports from Kadim et al11 who found Acinetobacter calcoaceticus (41.3%) as most common organism followed by Enterobacter aerogenes (15.9%) and Klebsiella pneumoniae (10.9%). Tiker et al reported Escherichia coli as most common organism that caused neonatal cholestasis sepsis at neonatology ward (46.6%), followed by Klebsiella pneumoniae and Pseudomonas aeruginosa.

Out of 65 cases of gram negative sepsis and 35 cases of gram positive sepsis hepato-biliary dysfunction was seen in 53.8% (n=35) and 40% (n=14) of cases respectively. This study documented that gram positive sepsis is equally responsible for hepatobiliary dysfunctions. In a study conducted by Shamir et al3 hepatic enzyme abnormalities were observed in 46.3% (25 of 54) of neonates with Gram-negative bacteremia and in 12.9% (4 of 31) of the neonates with coagulase-negative staphylococcal bacteraemia (gram positive).

We documented that sepsis associated cholestatic jaundice had an early onset (within 3 days), and subsided by 10th day in most of the neonates. Hepatic enzyme abnormalities take slightly longer time to appear, and the course is more protracted. Tiker et al2, in a retrospective analysis of 42 cases of early-onset conjugated hyperbilirubinemia (mean age of onset 10 days), documented culture-proven sepsis to be responsible in 35.7% of cases. Most other studies of conjugated hyperbilirubinemia in infants have focused on the chronic cholestatic jaundice in older neonates and infants, and have documented a small contribution of bacterial infection. The main causes found in these studies are congenital infections and extrahepatic biliary atresia13. In settings where facilities for detailed metabolic workup are not available, and initial workup for metabolic disorders is negative, it may be advisable to monitor infants with documented septicaemia carefully for a period of 1 month, especially when there is a trend towards improvement after the first week, before referring for invasive and expensive investigations.

The pathogenesis of hepatic dysfunction secondary to sepsis is found to be multifactorial. Enhanced haemolysis causing overload of immature liver function or hepatocellular damage has been implicated14; histopathologically, majority of cases reveal a pattern of intrahepatic cholestasis with little or no evidence of haemolysis or hepatic parenchymal damage15,16. The increased frequency of cholestasis associated with Gram-negative sepsis suggests a pathogenic role of circulating endotoxins in causing biliary stasis and hepatic parenchymal injury17. The intrinsic toxicity of endotoxins has been linked to lipid A portion, which has a similar structure in all Enterobacteriaceae whereas in case of Gram positive sepsis it occurs due to the presence of exposed peptidoglycan and a range of other secreted toxic products18. Cholestasis is also considered to be a consequence of the hepatocyte response to sepsis-associated cytokines. These cytokines exacerbate the normal physiologic cholestasis in neonates.

The limitation of our study was small sample size, done on blood culture proven cases only (blood culture is positive in <60% cases of neonatal septicemia19), no separation between extramural and intramural newborns, detailed investigations for other causes of neonatal cholestasis were not performed and the contribution of other metabolic and genetic causes could not be conclusively ruled out.

In conclusion, hepatobiliary dysfunction in form of raised transaminases and/or conjugated hyperbilirubinemia is very common during early part of sepsis and it usually resolves within one month of sepsis. So it is reasonable to carefully follow these patients for a period of time before planning for metabolic and hereditary causes.

References


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Predictors of Mortality in Neonates with Extensively Drug Resistant (XDR) Acinetobacter baumannii Infection in level III Extramural Neonatal Intensive Care Unit

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Abstract

Background: Multidrug resistant Acinetobacter baumannii infection emerged as important organism causing nosocomial neonatal sepsis. This study was done to determine risk factors associated with infection and mortality due to A.baumannii infection, in level III Extramural Neonatal Intensive Care Unit(NICU)

Method: Retrospective study was done in neonates with clinical proven infections with A.Baumanii over a period of nine months in level III Neonatal Intensive Care Unit (NICU) of Pediatric Superspeciality hospital. Demographic profile, clinical, laboratory and antimicrobial susceptibility data were collected and analyzed for high risk factors for mortality with A.baumanii Sepsis.

Results: Total 445 neonates screened, 184(41.3%) cases had sepsis and among these, twenty three(12.5%) neonates had A. baumannii infection. Twelve were term and 11 were preterm neonates. Mean Gestation Age and Weight of the neonates were 34.9 weeks and 2150 grams respectively. Proportion of deaths due to A.baumannii infection was 21.7%. All neonates required ventilator care and received empiric antibiotic therapy. Seven neonates underwent surgery because of major congenital malformations. Pneumonia was the most common infection. Significant high risk factors associated with mortality were weight on admission and duration of mechanical ventilation. All 23 neonates were resistant to carbapenems.

Conclusion: A.baumannii is alarming in neonates, especially preterm and low birth weight and associated with significant mortality. Rational antibiotic therapy and vigilant infection control is the key to control A.baumannii infection.

Contributors: MJ& HG was involved in designing the study and preparation of manuscript and will act as a guarantor. SJ & KK was involved in data collection and manuscript writing. VD, DM & SK were involved in analysis and manuscript writing. HG & VM analyzed all the microbiology data and was involved in manuscript writing.

Key Words-Acinetobacter baumannii; Extensive Drug resistance; Neonatal Infection; Mortality

Introduction

Neonatal sepsis is a significant cause of morbidity and mortality in the neonates. Patients in NICU (Neonatal Intensive Care Unit) are at high risk of Healthcare Associated Infections (HAIs), because of the prolonged hospitalization, and frequent invasive procedures. Gram negative Multi-drug (MDR) and Extensive drug resistant (XDR) Acinetobacter baumannii infections have emerged as an important cause of HAIs, mostly in patients with impaired host defense.¹ In India, according to National Neonatal Perinatal Database (NNPD) 2003, systemic sepsis contributed to 39.7% and 37.6% of the morbidities and mortalities respectively with Acinetobacter accounting for 3.4% of total sepsis in extramural NICU.²

Acinetobacter spp. is gaining importance as a potential pathogen in neonatal septicemia because of its frequent isolation and multidrug resistance.³ Because of rapid acquisition of a wide variety of antibiotic resistance genes, it is causing serious therapeutic problems worldwide. Infections due A. baumannii have been associated with high morbidity and mortality rates, prolonged hospital stay and substantial healthcare expense.⁴ High index of suspicion, early diagnosis and appropriate antimicrobial therapy are of utmost importance to prevent morbidity and mortality. This study was done to evaluate the
predictors of mortality in out born neonates with *A. baumannii* infection and to determine their antibiotic sensitivity and resistance pattern.

**Materials and Methods**

**Study Design**

This retrospective cohort study was conducted in the extramural NICU of a Government referral Pediatric Superspeciality hospital in North India.

**Patient identification**

All neonates with culture proven *Acinetobacter baumannii* infections from any sterile body fluid, during January 2010 to October 2010 were included in the study. Diagnosis of infection was based on clinical data and isolation of bacteria.

**Data extraction**

The case records of neonates admitted in the hospital during this period were analyzed retrospectively in a predesigned Performa, by accessing the case records from the medical record office of the hospital. The following parameters were collected and analyzed: maternal risk factors, gender, birth weight, age, gestational age, place of delivery, previous hospitalization, duration of NICU stay, underlying disease, use of antibiotics, ionotropes, steroids, invasive procedures, duration of mechanical ventilation, use of a central or peripheral venous catheter, urinary catheters, major surgical procedures, site of isolation of organisms, their susceptibility to antibiotics and outcomes were noted.

**Definitions**

* A. baumannii infection was confirmed in a neonate with clinical evidence of infection with isolation of *A. baumannii* from sterile body fluid.

Standard definitions for nosocomial infections were used according to the Center for Disease Control and Prevention. Sepsis was defined as Systemic Inflammatory Response Syndrome in the presence of or as a result of suspected or proven infection. Severe sepsis was defined as sepsis plus one of the following: cardiovascular organ dysfunction or acute respiratory distress syndrome or two or more other organ dysfunctions. Septic shock was defined as presence of sepsis along with cardiovascular dysfunction. Pneumonia was defined when there was isolation of *A. baumannii* from pulmonary secretions along with positive radiological findings and signs and symptoms suggestive of infection. Ventilator-associated pneumonia (VAP) was diagnosed based on Centers for Disease Control and Prevention, clinical, radiographic and microbiologic criteria. MDR was defined as non-susceptibility to at least one agent in all but two or fewer antimicrobial categories (i.e. bacterial isolates remain susceptible to only one or two categories).

**Microbiological methods**

Blood cultures were obtained in Bactec culture bottles and other sterile body fluids were obtained in sterile containers before starting antibiotics in symptomatic cases and subcultures were done on blood agar, heated blood agar, McConkey’s medium for further colony growth. Late lactose fermenters were identified and further gram staining was done. Gram negative coccobacilli which showed negative oxidase test were further identified by Vitek-2 identification system. Antimicrobial susceptibility to colistin was tested with the disk diffusion method following Clinical Laboratory Standards Institute guidelines. Repeat cultures were taken whenever antibiotics were changed. In vitro sensitivities were carried out using disc method for the following antibiotics: Imipenem, piperacillin-tazobactam, colistin, tobramycin, netilmicin, trimethoprim - sulphamethoxazole, amikacin, gentamicin, cefotaxime, ceftriaxone, cefepime, ciprofloxacin, tetracycline, ampicillin.

**Statistical Analysis**

All the data was collected in a predesigned proforma in excel 8.0 and was analyzed using SPSS-16.0 version. *P* value of < 0.05 was considered significant. Continuous variables were expressed as Mean and Standard Deviation. Categorical variables were expressed as percentage of the total number of patients analyzed. Student- t test was used to compare continuous variables, as appropriate.

**Results**

Total 445 neonates were admitted during the study period, out of which 184(41.3%) had clinical sepsis, *Acinetobacter* was present in 23 (12.5%) cases. Incidence of *A. baumannii* sepsis was 5.1%. Mean gestational age and weight of the neonates were 34.9 (±4.48) weeks and 2150 (±815.5) grams respectively. Demographic profile and risk factors are given in table 1. Seven (30%) neonates had major congenital malformations requiring surgical intervention, out of which 2 were term with congenital diaphragmatic hernia and 5 had tracheo-esophageal fistula. All of them had *A. baumannii* pneumonia. Three (12.5%) neonates were admitted with the diagnosis of respiratory distress syndrome (RDS) and meconium aspiration syndrome (MAS) respectively. Pneumonia and perinatal asphyxia was present in four (17.4%) and eight (34.7%) neonates respectively, at the time of admission. Shock was present in 56.5% neonates at the time of admission. Ventilator care was required in all neonates, central line in eighteen (78.2%), urinary catheter in two (8.7%) neonates. All neonates received two or more
antibiotics before the onset of A. baumannii infection. The mean duration of antibiotics after Acinetobacter infection was 11.45±10 days. Previous hospitalization was present in 52.1% neonates with A. baumannii infection and in 60% of the neonates who expired. Blood culture, endotracheal lavage culture, and urine culture showing A. baumannii was positive in two (8.7%), 22(95.6%), and one (4%) neonate respectively.

Case fatality was 21.7% (5/23), three neonates were premature and had RDS and two had major congenital malformations requiring surgery. The mean days of hospitalization were 28.5±23.3 days and that in expired neonates were 22±18.3 days. On univariate analysis, significant risk factors associated with mortality were weight on admission and duration of mechanical ventilation as shown in table1. Causes of death in all the neonates were severe sepsis secondary to A. baumannii infection. In present study majority 22(95.6%) of A. baumannii were XDR and one (4.3%) was MDR. A. baumannii showed 100% sensitivity to colistin as shown in table II. Carbapenems which were previously reported to be effective against this organism showed 100% resistance. Piperacillin-tazobactam, third and fourth generation cephalosporins also showed 100% resistance. Aminoglycosides (netilmicin and tobramycin) and tetracyclines showed ~40% sensitivity. Other antibiotics such as ampicillin and fluoroquinolones showed 7% sensitivity. Eleven neonates received colistin, out of which nine survived and two expired. All other neonates were treated with antibiotics according to sensitivity pattern. A. baumannii was sensitive to only colistin in all expired patients, except one, which showed sensitivity to tetracycline. Only two of the five expired patients received colistin.

**Discussion**

A. baumannii has emerged as an important nosocomial pathogen and outbreaks due to multi drug-resistant strains have been difficult to control, especially in Intensive Care Units. The mortality rate in present study was 21.7% as compared to in the previous studies which reported mortality rates ranging from 10.5% to 42.3%.

On univariate analysis duration of mechanical ventilation and low birth weight were found to be significant risk factors leading to mortality. Other studies have shown inappropriate antibiotic treatment, multi-resistant type, leukopenia, weight <1 kg, preterm with gestational age 28 weeks or less, poor perfusion, low platelets, metabolic acidosis, shorter length of stay to be associated with higher mortality rates. Mortality rates were higher in preterm neonates which can be explained by low birth weight and decreased immunity in such neonates.

Though statistically not significant, mortality rates were higher in those who presented to us at a later day of life and with previous hospital stay; this can be attributed to the lapses in infection control practices, irrational use of antibiotics leading to resistant strains and the highly virulent nature of the organism.

Surgical patients had a mortality rate of 28% (2/7). The high mortality rate in this group is probably owing to the multiple human and non-human reservoirs the patient is exposed and to the prolonged ventilator care as required by some of these patients. Once considered an opportunistic pathogen of low virulence, A. baumannii has been implicated in various types of infections including bacteremias, pneumonias, meningitis, and urinary tract infections. Studies have shown that moisturized respirometers were capable of aerosolizing Acinetobacter which is difficult to control. Pneumonia (91%) was the most common presenting feature in our study.

Acinetobacter can survive for long periods in dry as well as moist environment and at different temperature and pH values thereby facilitating transmission by human reservoir and inanimate sources and contributing to the emerging endemic nature of this organism.

Prolonged survival on inanimate surfaces, high colonization rates among hospitalized patients and frequent contamination of healthcare workers hands facilitate the dissemination of this organism.

Colistin was found to be the most effective drug, aminoglycosides and tetracyclines showed variable sensitivity. Cisneros et al had reported a drastic decline in imipenem susceptibility of A. baumannii from 100% in 1991 to 50% in 2000. In our study, carbapenems showed 100% resistance to A. baumannii. The high resistance rates found in this study may be associated with the fact that majority of these neonates were admitted in some small hospitals and received multiple broad spectrum antimicrobials for both prophylactic and therapeutic treatment. In present study, empiric antibiotics were received by all neonates, 91% and 78% neonates received amikacin and third generation cephalosporins respectively before A. baumannii infection, 52% received piperacillin tazobactam and 47% received meropenem. This practice led to the emergence of multidrug resistant strains due to the acquisition of gene encoding resistant determinants, production of b-lactamases and aminoglycoside-modifying enzyme. Antibiotics should not be used empirically and when used therapeutically they should be used rationally and antibiotic cycling regimes should be practiced.

Colistin seems to be one of the few effective and available drugs for these infections. It is a relatively low-cost drug, which has been commonly used for resistant gram-negative bacterial infections in resource
limited settings, despite the concerns about toxicity. However in a recent study, colistimethate intravenous administration was found to be safe and efficacious for multi-drug resistant Gram-negative infections in term and preterm neonates including extremely low birth weight neonates.\textsuperscript{23} Colistin should be reserved for salvage therapy rather than being routinely administered. New safer antibiotics are needed for the treatment of carbapenem resistant \textit{A.baumannii} infections.

It is clear from the results that invasive procedures in immunocompromised hosts and lapses in infection control policies are making \textit{A.baumannii} a threat in NICUs. Infection control policies, quality care, education of medical and nursing personnel and both active and passive surveillance should be strictly practiced to prevent this HAI.

Limitations of this study are its small sample size and retrospective nature.

In conclusion, this study addresses to the increasing prevalence of multidrug resistant isolates of \textit{A.baumannii} which are highly fatal and therefore the pressing need for implementation of infection control policies, continuous bacteriological surveillance and rational use of antibiotics.

**Table 1:** Demographic Characteristics & Risk Factors for Mortality of the Study Cases (N=23)

<table>
<thead>
<tr>
<th>DEMOGRAPHIC CHARACTERISTICS</th>
<th>ALIVE (n=18)</th>
<th>DEAD (n=5)</th>
<th>TOTAL (23)</th>
<th>P VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male gender</td>
<td>12</td>
<td>4</td>
<td>16</td>
<td>0.63</td>
</tr>
<tr>
<td>Mean Weight on admission (grams)</td>
<td>2323 (±770.1)</td>
<td>1527 (±718.6)</td>
<td>2150 (±815.5)</td>
<td>0.05</td>
</tr>
<tr>
<td>Mean Gestational age(weeks)</td>
<td>35.6(±3.5)</td>
<td>32.6(±6.9)</td>
<td>34.9(±4.48)</td>
<td>0.187</td>
</tr>
<tr>
<td>Mean Day of life at admission</td>
<td>4.2(±6.2)</td>
<td>9.6(±9.7)</td>
<td>5.4(±7.2)</td>
<td>0.142</td>
</tr>
<tr>
<td>Mean duration of NICU stay at our hospital (days)</td>
<td>30.3(±24.7)</td>
<td>22(±18.7)</td>
<td>28.5(±23.3)</td>
<td>0.495</td>
</tr>
<tr>
<td>Mean duration of antibiotics before onset of infection (days)</td>
<td>11.2(±12.1)</td>
<td>7.2(±2.1)</td>
<td>10.3(±10.8)</td>
<td>0.476</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RISK FACTORS FOR MORTALITY</th>
<th>ALIVE (n=18)</th>
<th>DEAD (n=5)</th>
<th>TOTAL (23)</th>
<th>P VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgical procedure</td>
<td>5</td>
<td>2</td>
<td>7</td>
<td>0.633</td>
</tr>
<tr>
<td>Urinary catheterization</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>0.434</td>
</tr>
<tr>
<td>Central venous catheter</td>
<td>14</td>
<td>4</td>
<td>18</td>
<td>0.964</td>
</tr>
<tr>
<td>Mean duration of Mechanical ventilation (days)</td>
<td>9.2(±8.1)</td>
<td>18.8(±9.2)</td>
<td>13(±8.8)</td>
<td>0.03</td>
</tr>
<tr>
<td>Blood stream infection</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>0.434</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>18</td>
<td>4</td>
<td>22</td>
<td>0.217</td>
</tr>
<tr>
<td>Urinary tract infection</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0.782</td>
</tr>
<tr>
<td>Presence of shock</td>
<td>10</td>
<td>3</td>
<td>13</td>
<td>0.883</td>
</tr>
<tr>
<td>Pre-lacteal feeds</td>
<td>4</td>
<td>2</td>
<td>6</td>
<td>0.480</td>
</tr>
<tr>
<td>Home delivery</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>0.848</td>
</tr>
<tr>
<td>Previous hospitalization</td>
<td>9</td>
<td>3</td>
<td>12</td>
<td>0.730</td>
</tr>
</tbody>
</table>

**Table 2:** Sensitivity Pattern of Acinetobacter Spp. Isolated from Study Cases (N=23)

<table>
<thead>
<tr>
<th>Antibiotics</th>
<th>Sensitive</th>
<th>Resistant</th>
<th>Percentage Susceptibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ampicillin</td>
<td>2</td>
<td>21</td>
<td>8.6%</td>
</tr>
<tr>
<td>Ceftriaxone</td>
<td>0</td>
<td>23</td>
<td>0%</td>
</tr>
<tr>
<td>Cefotaxime</td>
<td>0</td>
<td>23</td>
<td>0%</td>
</tr>
<tr>
<td>Cefipime</td>
<td>0</td>
<td>23</td>
<td>0%</td>
</tr>
<tr>
<td>Piperacillin - Tazobactum</td>
<td>0</td>
<td>23</td>
<td>0%</td>
</tr>
<tr>
<td>Tetracycline</td>
<td>9</td>
<td>14</td>
<td>39.1%</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>2</td>
<td>21</td>
<td>8.6%</td>
</tr>
<tr>
<td>Amikacin</td>
<td>1</td>
<td>22</td>
<td>4.3%</td>
</tr>
<tr>
<td>Gentamicin</td>
<td>3</td>
<td>20</td>
<td>13%</td>
</tr>
<tr>
<td>Netilmicin</td>
<td>8</td>
<td>15</td>
<td>34.7%</td>
</tr>
<tr>
<td>Tobramycin</td>
<td>10</td>
<td>13</td>
<td>43.4%</td>
</tr>
<tr>
<td>Trimethoprim - sulphamethoxazole</td>
<td>0</td>
<td>23</td>
<td>0%</td>
</tr>
<tr>
<td>Imipenem</td>
<td>0</td>
<td>23</td>
<td>0%</td>
</tr>
<tr>
<td>Colistin</td>
<td>23</td>
<td>0</td>
<td>100%</td>
</tr>
</tbody>
</table>

**References**


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Assessing the Utilization of Maternal and Neonatal Health Care Programmes in Terms of Neonatal Mortality – A descriptive study

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Abstract

Objective: Assessing the utilization of maternal and neonatal health care programmes in terms of neonatal mortality – A descriptive study.

Methods: In this descriptive study, a total of 245 neonates who were referred to a tertiary care teaching institute were enrolled in the study and the following information were recorded - maternal details, place of birth, person conducting the deliveries, utilization of the various health services like use of ambulance facility (102 &108), antenatal visit by ASHA/AWW, information about JSY/JSSY, stabilisation of newborn before and during transportation, clinical assessment of the new born on hospital arrival. Detailed clinical assessment and management was done as per the standard protocol.

Results: Total 245 newborns were included in the study. Out of which 46 (18.8%) babies were delivered at home, 82(33.5%) at private hospital and 117(47.8%) at government hospital. Only 124(50.6%) knew about JSY/JSSK schemes. ASHA/AWW visited in 130 (53.1%) cases for antenatal check-ups. Government ambulance facility was utilised by 80 (32.6%) out of which only 24 (9.8%) utilised 102 and 56(22.8%) used 108 services. There is no statistically significant difference among the neonates expired 22 (48.9%) and discharged 108 (54%) where ASHA/AWW antenatal visits were done. Mother’s age was below 20 year at the time of first delivery in 3.7% cases only.

Among the expired neonates (45) babies delivered at home by unskilled birth attendants were 73.3% (OR 16.60, 95% CI.4. 57-60.19, p=0.0001), Information about JSY/JSSK was only in 16 (35.6%) [OR 3.31, 95% CI.13.34, p=0.03], babies delivered at private hospital (35.5%) as compared to a government hospital (15.6%). Total duration of transport > 1hr, gestational age <28weeks, weight at the time of admission <1000gm [OR 21.64, 95%CI2.28-205.23, p=0.007],SPO2 at the time of admission measured by pulse oximeter <90% [OR 3.69, 95% CI.1.08-12.58, p=0.03] were found to be significant risk factors for neonatal mortality. Commonest cause of neonatal death was found to be birth asphyxia (44.4%) followed by sepsis (35.6%) and prematurity (24.4%).

Conclusions: Awareness, Integration & Improvement in the quality of maternal & neonatal health care services and community participation at large is the need of the hour to achieve the goal of India new born action plan (INAP) 2030.

Key Words: Maternal and neonatal health Services, Neonatal mortality, India New Born Action Plan (INAP).

Introduction

As per India New born Action Plan (INAP), it is expected that India will achieve the goals of “Single Digit NMR by 2030, five years ahead of Every Newborn Action Plan (ENAP) globally, which is expected to be achieved by 2035”. In India, NMR is 29 per 1000 live birth, and it contributes 56% to the under 5 mortality (SRS 2012).

Neonatal mortality reflects overall utilization of health services by community, infra structure, and involvement of health care personnel in providing neonatal care. There is a huge gap between urban and rural mortality rates and geographical variation due to inequitable distribution of the health care services².

Because the health of the mother and newborn are closely related, they must be considered together when planning strategies to improve the perinatal and neonatal outcomes. It is important to highlight the fact that peak period of vulnerability for both the mother and newborn is around pregnancy and childbirth. Thus, interventions must largely focus on addressing joint outcomes³.
In 2005, the Lancet Neonatal Survival series estimated that 12%-26% of neonatal deaths could be prevented by universal outreach and family-community care during the antepartum, peripartum, and postpartum period by promoting uptake of care and evidence-based newborn practices. The recent Lancet Every Newborn series supports community based strategies to improve intervention coverage and reduce inequities.

These interventions include birth preparedness, recognition of and appropriate response to danger signs in the antenatal & intrapartum period; skilled health care personal during delivery and early postnatal visit for recognition & management of maternal and neonatal illness. A coordinated approach would benefit both mother and newborn simultaneously.

Our study aims to find out the impact of these health care programme on the neonatal mortality rate.

METHODS: A descriptive study was conducted in the department of paediatrics at Uttar Pradesh Rural Institute of Medical Sciences & Research (UPRIMS&R), Saifai, India from April 2015 to September 2015. Ethical clearance was obtained from institutional ethical committee (IEC). The study protocol was fully explained to parents/guardian and written informed consent was obtained. During the study period of six months from April 2015 to September 2015, a total of 245 neonates born at home, government, private hospitals and transferred to our neonatal intensive care unit, were enrolled in the study. A pretested proforma was used to record data regarding maternal and birth details, modes of transport, stabilization before & during transport and neonatal condition on admission.

Maternal characteristics were noted in terms of mother’s age at the time of delivery and birth order. Birth details were noted in terms of mode of delivery (vaginal/ caesarean section), place of delivery (home, government or private hospital), personnel who conducted the delivery (unskilled /skilled birth attendants). Transport details such as mode of transport (government ambulance (102/108), private ambulance, personal means), time taken to reach hospital, stabilization before transport (oxygen, intravenous fluids, temperature maintenance). Neonates were assessed on admission in terms of gestational age (last menstrual period and new Ballard scoring), weight (electronic weighing scale), hypothermia (axillary temperature <36°C by digital thermometer), capillary refill time (>3s as prolonged), oxygen saturation (pulse oximeter,<90% or >90%), hypoglycaemia (blood sugar by glucometer < 45mg/dl). Clinically birth asphyxia was defined as presence of any one of the following: 1) Gasping or ineffective breathing or lack of breathing at one minute of life, 2) Need for positive pressure ventilation for >1 minute, 3) Apgar score <3 at 5 minute or longer. Respiratory distress was diagnosed in presence of at least any one of the following criteria: 1) Respiratory rare > 60/minute recorded for at least 1 minute 2) Severe chest indrawing 3) Expiratory grunt/grunting and 4) Apnea or gasping. Meconium Aspiration Syndrome was diagnosed in presence of two of the following: 1) Meconium staining of liquor or staining of nails or umbilical cord or skin 2) Respiratory distress soon after birth/ within one hour of birth and 3) Radiological evidence of aspiration pneumonitis (atelectasis and/or hyperinflation).

Septicaemia was classified as early onset (Onset <72 hours) or late onset (Onset >72 hours). Culture negative or clinical sepsis was diagnosed in presence of any one of the following criteria: 1) existence of predisposing factors such as maternal fever or foul smelling liquor or prolonged rupture of membranes (>18 hrs), 2) positive septic screen (two of the five parameters namely, TLC <5000/mm3, I/T ratio of > 0.2, absolute neutrophil count less than 1800/mm3, C-reactive protein >10 mg/l and micro ESR>15 mm in 1st hour), and 3) radiological evidences of pneumonia. Culture positive sepsis was diagnosed in an infant having clinical picture suggestive of septicemia, pneumonia or meningitis along with isolation of pathogens from blood or CSF or urine or abscess.

Neonates were investigated, managed and monitored as per standard protocols. Outcome was assessed in terms of expiry or survival. Neonates who left against medical advice were excluded from the study therefore data was not collected. Separate data regarding birth injuries was not included in the study however major congenital malformation incompatible for life was excluded from the study.

Parents or guardians were enquired about information regarding Janani Shishu Suraksha Karyakram (JSSK) OR Janani suraksha yojna (JSY) and about antenatal visits by AWW/ASHA (Angan Wadi Worker / Accredited Social Health Activist).

Data were analysed using SPSS version 13.0. All quantitative variables such as gestational age, birth weight were compared using student’s t test and categorical variables were analysed using chi-square test and fisher exact test. P value <0.05 was considered significant. Multivariate regression analysis was used to adjust confounding factors on mortality.

Results

Table 1 shows maternal characteristics and 2 show clinical profile of survived & expired neonate. A total of 245 neonates (60.8 % males and 39.2% female) were included in the study. Out of which 46 (18.8%) babies were delivered at home and deliveries were conducted by unskilled birth attendant.
Our study showed that there is a lack of information and awareness on the schemes JSY /JSSK. Only 124 (50.6%) knew about this programme. ASHA/AWW visited only in 130 (53.1%) cases for antenatal check-ups. There is no statistically significant difference among the neonates expired 22 (48.9%) and discharged 108 (54%) where ASHA/AWW antenatal visits were done.

Government ambulance facility for neonatal transport was used only in 80 (32.6%) out of which only 24 (9.8%) utilized. 102 and 56 (22.8%) used 108 services.

Our study showed that teenage pregnancy is gradually decreasing. Age of the mother at the time of first delivery was less than 20 year (3.7%).

Neonatal mortality was significantly less when baby referred or admitted early i.e. <24 hrs age at the time of admission (p=0.02) and total duration of transport <1hr [OR0.01, 95%CI.0.001-0.05, p=0.001].

Among the expired neonate, babies delivered by TBA was 73.3% (OR16.60, 95%CI.4.57-60.19, p=0.0001), Information about JSY/JSSK was only in 16(35.6%) [OR 3.31, 95% CI.13.34, p=0.03], Total duration of transport > 1hrs, weight at the of admission <1000gm [OR 21.64, 95% CI.28-205.23, p=0.007]. SPO2 at the time of admission measured by pulse oximeter is <90% [OR 3.69, 95%CI.1.08-12.58, p=0.03] and baby delivered at a private hospital had high mortality rate (35.5%) as compared to a Govt. hospital (15.6%).

Distribution of patients as per the primary diagnosis at the time of admission was; sepsis (34.7%), asphyxia (33.1%), prematurity (26.5%), neonatal hyperbilirubinemia (38%), meconium aspiration syndrome (10%), others (3%).

Out of 245 neonates, 45 expired thus mortality rate was 18.3%. Table 1 shows causes of mortality, birth asphyxia 44.4%, prematurity 24.4%, meconium aspiration syndrome 4.4%. Table 1 & 2 show the profile of expired and survived patients. Table 3 depicts the association between various factors and mortality by logistic regression analysis.

**Discussion**

Ministry of Health and Family Welfare GOI, launched the Janani Shishu Suraksha Karyakram (JSSK) in June 2011.

### Table-1: Maternal characteristics

<table>
<thead>
<tr>
<th>Parameters</th>
<th>No. of neonates (n=245)</th>
<th>Expired (n=45)</th>
<th>Survivors (n=200)</th>
<th>p-value²</th>
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<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>Gestational age in weeks</td>
<td></td>
<td></td>
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<td></td>
</tr>
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<td>&lt;28</td>
<td>28</td>
<td>11.4</td>
<td>23</td>
<td>51.1</td>
</tr>
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<td>56</td>
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<td>24.4</td>
</tr>
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<td>35-37</td>
<td>60</td>
<td>24.5</td>
<td>7</td>
<td>15.6</td>
</tr>
<tr>
<td>&gt;37</td>
<td>101</td>
<td>41.2</td>
<td>4</td>
<td>8.9</td>
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<tr>
<td>Mother’s age in years</td>
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<td></td>
<td></td>
<td></td>
</tr>
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<td>2</td>
<td>4.4</td>
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<tr>
<td>20-25</td>
<td>154</td>
<td>62.9</td>
<td>28</td>
<td>62.2</td>
</tr>
<tr>
<td>26-30</td>
<td>67</td>
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<td>12</td>
<td>26.7</td>
</tr>
<tr>
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<td>15</td>
<td>6.1</td>
<td>3</td>
<td>6.7</td>
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<tr>
<td>Antenatal visit by ANM/ASHA</td>
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<td>53.1</td>
<td>22</td>
<td>48.9</td>
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<tr>
<td>Information about JSY/JSSY</td>
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<td>50.6</td>
<td>16</td>
<td>35.6</td>
</tr>
<tr>
<td>Place of delivery</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Home</td>
<td>46</td>
<td>18.8</td>
<td>22</td>
<td>48.9</td>
</tr>
<tr>
<td>Govt. hospital</td>
<td>117</td>
<td>47.8</td>
<td>7</td>
<td>15.6</td>
</tr>
<tr>
<td>Private hospital</td>
<td>82</td>
<td>33.5</td>
<td>16</td>
<td>35.6</td>
</tr>
<tr>
<td>MOD</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSCS</td>
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<td>18.0</td>
<td>7</td>
<td>15.6</td>
</tr>
<tr>
<td>VD</td>
<td>201</td>
<td>82.0</td>
<td>38</td>
<td>84.4</td>
</tr>
<tr>
<td>Delivery conducted by</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Unskilled birth attendant</td>
<td>54</td>
<td>22.0</td>
<td>33</td>
<td>73.3</td>
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<tr>
<td>Skilled birth attendant</td>
<td>191</td>
<td>78.0</td>
<td>12</td>
<td>26.7</td>
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</tbody>
</table>

¹Chi-square test, ²Multiple response, *Significant
so that every mother and infant (up to one year of age) has ensured access to get a range of health services free of cost. Since the roll out of the scheme there is unprecedented rise in the institutional deliveries. It is documented that states with higher institutional births (e.g., Kerala) have lower neonatal mortality than those with lower institutional births. (e.g. Uttar Pradesh). In our study 46 (18.8%) of deliveries are still occurring at home and had higher mortality 22 (48.9%) as compared to government hospital deliveries 7 (25.6%) which is statistically significant (p=0.0001). Only 117 (47.8%) deliveries were taking place in Govt. hospital and 82 (33.5%) still occurring in private hospitals.

Table 2: Profile of survived and expired neonates

<table>
<thead>
<tr>
<th>Parameters</th>
<th>No. of neonates (n=245)</th>
<th>Expired (n=45)</th>
<th>Survivors (n=200)</th>
<th>p-value*</th>
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</thead>
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<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>Probable diagnosis at admission$</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Asphyxia</td>
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<td>33.1</td>
<td>20</td>
<td>44.4</td>
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<td>Prematurity</td>
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<td>11</td>
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<td>Sepsis</td>
<td>85</td>
<td>34.7</td>
<td>15</td>
<td>33.3</td>
</tr>
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<td>MAS</td>
<td>10</td>
<td>4.1</td>
<td>1</td>
<td>2.2</td>
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<tr>
<td>NNH</td>
<td>38</td>
<td>15.5</td>
<td>3</td>
<td>6.7</td>
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<tr>
<td>Others</td>
<td>3</td>
<td>1.2</td>
<td>0</td>
<td>0.0</td>
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<tr>
<td>Stabilization before referral or during transport (IVF, Oxygen, temperature)</td>
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<td>47.8</td>
<td>26</td>
<td>57.8</td>
</tr>
<tr>
<td>Mode of transport</td>
<td></td>
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<td>Govt. Ambulance</td>
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<td>32.7</td>
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<td>35.6</td>
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<td>Own vehicle</td>
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<tr>
<td>Duration of transport</td>
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<td></td>
</tr>
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<td>1-2 hr</td>
<td>29</td>
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<td>15</td>
<td>33.3</td>
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<td>&gt;2 hr</td>
<td>29</td>
<td>11.8</td>
<td>22</td>
<td>48.9</td>
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<tr>
<td>Age at admission in days</td>
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<td></td>
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<tr>
<td>&lt;24 hrs</td>
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<td>12</td>
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<tr>
<td>1-2</td>
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<td>17.1</td>
<td>14</td>
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<tr>
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<tr>
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<td>35.6</td>
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<tr>
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<td></td>
<td></td>
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<tr>
<td>&lt;1 kg</td>
<td>22</td>
<td>9.0</td>
<td>16</td>
<td>35.6</td>
</tr>
<tr>
<td>1-1.5 kg</td>
<td>56</td>
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<td>14</td>
<td>31.1</td>
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<tr>
<td>1.51-2.5 kg</td>
<td>99</td>
<td>40.4</td>
<td>9</td>
<td>20.0</td>
</tr>
<tr>
<td>&gt;2.5 kg</td>
<td>68</td>
<td>27.8</td>
<td>6</td>
<td>13.3</td>
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<td>14</td>
<td>31.1</td>
</tr>
<tr>
<td>Hypoglycemia</td>
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<td>3.7</td>
<td>2</td>
<td>4.4</td>
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<tr>
<td>Delayed CRT</td>
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<td>11.1</td>
<td>10</td>
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<td>Cyanosis peripheral</td>
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<tr>
<td>SPO2</td>
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<td>&lt;90%</td>
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<td>27</td>
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<tr>
<td>≥90%</td>
<td>170</td>
<td>69.4</td>
<td>18</td>
<td>40.0</td>
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</tbody>
</table>

1Chi-square test, $Multiple response, *Significant
JSSK ensures that every mother and infant has access to health services, however the uptake of this scheme is still slow and there exists a lack of awareness about the scheme\textsuperscript{7}. Our study shows that there is a lack of information and awareness on the schemes JSY / JSSK. Out of 245, only 124 (50.6\%) knew about this programme, among these 16 (35.6\%) expired, 108 (54\%) were discharged which is statistically significant \((p<0.02)\).

The Government of India launched the HBNC (home based newborn care) programme in 2011 with the purpose of improving community newborn care practices and early detection of neonatal illnesses through home visits by the ASHAs. One of the objectives of HBNC is to support the family in adopting healthy practices and behaviour, and to build the confidence and skills of the mother to safeguard her health and that of her newborn by mobilizing all pregnant mothers and to ensure that they receive the full package of antenatal care\textsuperscript{8}.

Our study shows that only in 130 (53.1\%) cases, ASHA/AWW visited for antenatal check-ups. There is no statistically significant difference \((P > 0.05)\) among the neonates expired 22 (48.9\%) and discharged 108 (54\%) where ASHA/AWW antenatal visits were done. This shows that quality of health care delivery as per expectation was not done.

It is perceived by the community that private stakeholders are better health care providers therefore more male baby is admitted in a public sector hospital\textsuperscript{9}. However in our study the number of admissions for male babies was much higher 149 (60.8\%) as compared to female babies 96 (39.2\%). This may be because this is the only tertiary care referral hospital in this area.

Under NRHM (national rural health mission) launched in 2005, National Ambulance Service (NAS) has two sub categories: Dial 108 catering to the patients of critical care, trauma and accidents victims and dial 102 to cater to the needs of infants and pregnant women\textsuperscript{10}. In our study government ambulance facility for neonatal transport was used only in 80 (32.6\%) out of which only 24 (9.8\%) utilized 102 and 56 (22.8\%) used 108 services. However private ambulance used by 82 (33.5\%) and own vehicles are used by 83 (33.9\%).

The duration of transport is considered a probable risk factor for adverse neonatal outcome\textsuperscript{11,12,13}. In our study Prolonged transport (>1 hr) is found to increase the mortality 22 (48\%) than for shorter duration (<1 hr) mortality is less 8 (17.8\%) which is statistically significant \((P=0.0001)\). Prior stabilization before and during transport will reduce morbidity and mortality\textsuperscript{14}. However in our study none of the neonate was completely stabilized in terms of IVF, Oxygenation and temperature maintenance. Here we conclude that neonates should be transported with in short period of time and should be stabilized before and during transport.

Incidence of hypothermia among the transported neonates in our study was not comparable to previous study\textsuperscript{15,16}. This may be because less time required to reach the hospital facility. However incidence of hypoglycaemia was comparable to the previous study\textsuperscript{17,18}.

Mortality is inversely related to gestational age, birth weight and time taken to reach the hospital\textsuperscript{19}. Neonates with gestational age below 28 weeks had greater mortality 23 (51.1\%) as compared to those full term neonate 4 (8.9\%), which is statistically significant \((p=0.0001)\). Extremely low birth babies (weight <1000gm) have higher mortality 16 (35.6\%) when compared with birth weight above 2.5 kg 6 (13.3\%) which is statistically significant \((P=0.0001)\). Deliveries taking place at home is 46 (18.8\%) and conducted by unskilled birth attendant constitute significant proportion of neonatal death 22 (48.9\%) which is statistically significant \((P=0.0001)\).

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Adjusted OR of mortality</th>
<th>95% confidence interval</th>
<th>(p)-value</th>
</tr>
</thead>
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<td></td>
</tr>
<tr>
<td>&lt;1 hr</td>
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<td>0.001-0.05</td>
<td>0.001*</td>
</tr>
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<td>0.07-2.40</td>
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<tr>
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<td>1.00 (Ref.)</td>
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<td></td>
</tr>
<tr>
<td>Weight at admission in kg</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>&lt;1 kg</td>
<td>21.64</td>
<td>2.28-205.23</td>
<td>0.007*</td>
</tr>
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<td>1-1.5 kg</td>
<td>6.74</td>
<td>1.16-39.11</td>
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</tr>
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<td>0.54-19.35</td>
<td>0.19</td>
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<td>&gt;2.5 kg</td>
<td>1.00 (Ref.)</td>
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<td>Delivery conducted by</td>
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<td></td>
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<td>Unskilled birth attendant</td>
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<td>1.00 (Ref.)</td>
<td></td>
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<td></td>
</tr>
<tr>
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</tr>
<tr>
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</tr>
<tr>
<td>(SPO_2)</td>
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<tr>
<td>&lt;90%</td>
<td>3.69</td>
<td>1.08-12.58</td>
<td>0.03*</td>
</tr>
<tr>
<td>(\geq 90%)</td>
<td>1.00 (Ref.)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\textsuperscript{analysis OR-Odds ratio, Ref: Reference, *Significant}
Measurement of oxygenation, SPO2 < 90% (OR: 3.69, 95% CI: 1.08-12.58, P = 0.03), by pulse oximeter, delayed capillary refill time (>3 sec.) and presence of peripheral cyanosis have been found to be significant (P<.005) cause of mortality18.

Multivariate logistic regression analysis revealed that deliveries conducted by unskilled birth attendant (OR: 21.64, 95% CI: 4.57-60.19, P value= 0.0001) birth weight < 1 kg (OR: 21.64, 95% CI: 2.28-205.23, P = 0.007*, transportation time > 1 h (OR: 0.01, 95% CI: 0.001-0.05, P = 0.001) to be significantly associated with mortality of transported neonates [Table 1].

In Our study birth asphyxia (44.41%) was the most important cause of neonatal mortality followed by sepsis (35.6%) and prematurity (24.4%) unlike Baqui et.al20 where the most important cause of mortality was prematurity (32%) and in Kumar et. al.21 sepsis was the main cause of death. This is because babies admitted to our institute are mostly from rural areas where lack of trained health care personnel were involved in neonatal resuscitation.

Limitation of our study were small sample size and lack of new born tracking system after discharge. Utilisation of various health services like information, quality of services about JSY/JSSK, Number of antenatal & postnatal visits and counselling regarding newborn and maternal health care by ASHA/AWW could have been taken.

Many of these interventions have been included in comprehensive packages of maternal and newborn health care programme but there is enough evidence, that this has not been widely adopted, accepted and adequately addressed. Newborn interventions rarely focus on integration with existing maternal and neonatal health care programs22,23.

For the prevention of neonatal mortality, good emergency obstetric care facility that requires for the treatment of complications that arise during pregnancy and at birth. Even if such facilities are available there is actually delays in seeking care, referral and in treatment after arriving at the facility24,25.

Conclusion

Government of India has instituted major public health programs to improve maternal and neonatal survival but these initiatives have not succeeded in significantly reducing neonatal mortality.

There is urgent need of continuum of care with integration of maternal and all the neonatal health care programs in India. This would foster continuity of care, cost-effectiveness and neonatal outcomes while avoiding vertical programs for either the mother or the newborn.

The above results have significant implications for policy making in reducing neonatal deaths in India.

What Is Already Known?
• Various government programmes are running for maternal and neonatal care.

What this study adds.
• Awareness, Integration & Improvement in the quality of maternal and neonatal health care programme, is the need of the hour to achieve the goal of INAP, 2030.
• Birth asphyxia still a major cause of neonatal mortality in rural areas followed by prematurity and sepsis.

Acknowledgement

Dr. Manish for his providing his technical assistance in formatting the text and figure.

Mr. Rjendra Mishra for his assistance in statistics during manuscript preparation.

Reference

7. MOHFW GOI, State of India’s new born (SOIN); 2014.p111.

National Level Training of Trainers (TOT) on Revised Accreditation Guidelines of Newborn Facilities (Based on Newer Guidelines 2016)

National Neonatology Forum, India (NNF) in support with UNICEF organized two days National Level Training of Trainers (TOT) on Revised Accreditation Guidelines of Newborn Facilities (Based on Newer Guidelines 2016) on 17th & 18th September, 2016 at Hotel Lemon Tree, Aerocity, Delhi. The meeting was started with lighting of lamp. Workshop was inaugurated by Dr. Ajay Khera Deputy Commissioner, Ministry of Health & Family Welfare, Govt. of India. Dr. Ajay Gambhir, Dr. Sunil Mehendiratta, Dr. A.K. Sangal were also present.
### NEOCON 2016 Pre-conference Workshops - 8th December 2016

1. Basic Ventilation & Advanced Ventilation  
2. Neonatal Procedures  
3. Facility Based Newborn Care  
4. Non-Invasive Ventilation - CPAP  
5. Neuro developmental Assessment & Follow up of high risk Newborn & Therapeutic Hypothermia (Head/whole body)  
6. Functional Echocardiography & Cranial Ultrasound  
7. KMC, Skin to Skin contact & Infection Control & Neonatal Nursing  
8. TPN, Fluid & electrolyte & Procedures in NICU & PICU

**Note:**
- Few more workshops will be declared in due course of time.
- Workshop Fee Rs. 1500/- and for Nurse Rs. 800/-
- For workshops participant must be registered for NEOCON-2016

Organizing committee has decided few prizes in the form of academic books, E-Reader etc. for those who register in early bird during NEOCON 2015 at Bhuvneshwar. Prizes will given during NEOCON 2016 at Indore.
Dry skin may compromise the skin barrier resulting in increased incidence of Atopic Dermatitis\(^1\)

Moisturization is important as it establishes a barrier against further drying and irritation\(^2\)

New and improved formula, Johnson's® baby skincare wipes

- Provides protection that helps prevent nappy rash
- Holds triple weight of moisturizing lotion
- Improves skin barrier up to 4 hours
- Effectively removes dirt, impurities and any residue such as faeces and urine

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