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RESEARCH ARTICLE

INCIDENCE OF LATE ONSET CULTURE POSITIVE NEONATAL SEPSIS AND ITS ANTIBIOTIC SENSITIVITY PATTERN.

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Abstract

Background and objectives: Sepsis is one of the leading causes of neonatal morbidity and mortality. Because of difference in local epidemiology and variation with time, regular monitoring and updates on pathogen and their antimicrobial sensitivity pattern is important for prevention and treatment. The aim of this study was to study the incidence of late onset Culture Positive Sepsis and Antibiotic Sensitivity Pattern at a Tertiary Care Centre and also evaluate the outcome of culture positive late onset sepsis.

Introduction:-

Sepsis is one of the leading causes of neonatal morbidity and mortality. Because of difference in local epidemiology and variation with time, regular monitoring and updates on pathogen and their antimicrobial sensitivity pattern is important for prevention and treatment.

Neonatal sepsis is a systemic inflammatory response to infection and/or isolation of bacteria from the blood stream in the first 28 days of life. When pathogenic organisms access into the blood-stream, they can cause an overwhelming infection which leads to develop septicemia. When these organisms predominantly localized to the lung or the meninges they may cause pneumonia and meningitis, respectively [1].

Systemic inflammatory response also describes a clinical syndrome in which there are two or more of the following symptoms: fever, hypothermia, tachycardia, tachypnoea and abnormal white blood cells in immature forms [1].

It is one of the most common causes of neonatal hospital admissions [2–4] and is estimated to cause 26% of all neonatal deaths worldwide [5]. It contributes to 30 to 50% of neonatal deaths in developing countries [6]. In India, the incidence of blood culture proven sepsis was reported as 8.5 per 1,000 live births for the year 2002–2003 by the National Neonatal Perinatal Database (NNPD report 2002-03) [7].

Neonatal sepsis is classified as early onset when it occurs within the first 72 hours of life and late onset when it occurs after 72 hours [8,9]. Early onset sepsis is caused by organisms prevalent in the maternal genital tract, labour room or operating theatre [10, 11] while late onset sepsis usually results from nosocomial or community-acquired infection [3, 11].Neonates are susceptible to sepsis as a result of their immature immune system, the decreased phagocytic activity of their white blood cells and their incompletely developed skin barriers [12–14]. Common risk factors for neonatal sepsis have been identified as prematurity and low birth weight, prolonged rupture of foetal membranes, maternal peri-partum pyrexia, obstructed labour and birth asphyxia [15–19].

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The organisms commonly associated with late onset sepsis include coagulase-negative Staphylococci (CONS), Staphylococcus aureus, Klebsiella pneumoniae, Escherichia coli, Enterobacter spp., Pseudomonas aeruginosa and Acinetobacter species. The bacteriological profile for causative organisms of neonatal sepsis differs significantly between developed and developing countries a pneumoniae is the most common bacterial agent causing neonatal sepsis in developing countries, while group B Streptococcus and coagulase-negative staphylococci (CONS) are the common agents in developed countries [11,20].

Even among developing countries, regional variation in prevalence of the bacterial agents causing neonatal sepsis exists. The spectrum of organisms that causes neonatal sepsis changes over times and varies from region to region, due to the changing pattern of antibiotic use and changes in lifestyle [21]. Therefore, periodic evaluation of organisms responsible for neonatal sepsis and their antibiotic sensitivity pattern is essential for the appropriate management of neonates.

After 2002 no major clinical study has been undertaken in India with respect to culture positive late onset sepsis & antibiotic sensitivity. Hence, this study was undertaken to provide further evaluation of culture positive late onset septicemia with reference to antibiotic sensitivity in tertiary care center in India.

Our aim was to assess the incidence of late onset culture positive sepsis in a tertiary care, neonatal intensive care unit in Pune, India and to study the sensitivity pattern and outcome of the same.

Materials and Methods:-

A Prospective observational hospital-based study was carried out among all the babies admitted or referred to our, level III NICU from December 2014 to July 2016.

All the neonates with features suggestive of late onset sepsis were included in the study after obtaining consent from their relatives.

Blood, CSF and urine culture and sensitivity analysis was done in department of microbiology, of our hospital.
The data regarding the 100 culture positivity status was plotted according to the causative organism and sensitivity to current antibiotics used in the NICU.

Blood culture and CSF culture were done on automated Bac T alert systems.

Culture reports were evaluated with regards to microorganism typing as well as antibiotic sensitivity based on disc diffusion.

Neonates with late onset culture positive sepsis were treated with appropriate antibiotics as indicated and were followed up with regards to short term outcome.

Statistical Analysis

All the collected data was entered in Microsoft Excel Sheet 2013.The data was then transferred and analyzed using SPSS ver. 21. Qualitative data was represented in the form of frequency and percentage while quantitative data was represented using Mean +/- S.D. Appropriate statistical tests were applied on the basis of type and distribution of data. A p-value of < 0.05 was taken as level of significance.

Results:-

Out of the 100 babies with late onset Culture Positive Sepsis, 69% were males while 31% were females. 54% delivered in our hospital while rest 46% were referred cases. Only 28% new-borns weight above 2.5 Kg while 24% were low birth weight. Very low birth weight was observed in 30% babies while 18% had extremely low birth weight (< 1 kg).

About one third of mothers (36%) delivered at term while 64% were pre-term deliveries. Out of these 64 pre-term deliveries, 12 females delivered before 28 weeks.

Table 6:-Distribution of subjects based on type of culture positive specimen

Culture positive Specimen	N	%
Blood	62	62.0%
Urine	40	40.0%
Pus	11	11.0%
CSF	5	5.0%

Blood sample was positive in most of the cases (62%) while urine, pus and CSF was positive in 40%, 11% and 5% cases.

Table 7:-Distribution of subjects based on type of culture positive specimen

Culture	N	%
Blood	46	46.0%
Urine	30	30.0%
Pus	6	6.0%
Blood + Urine	9	9.0%
Blood + CSF	3	3.0%
Blood + Pus	4	4.0%
CSF + Pus	1	1.0%
CSF +Urine	1	1.0%
Total	100	100.0%

Single organism was observed in 77% cases while in 23% cases more than one organism was isolated.

Isolated Blood culture alone was positive in 46% cases while isolated urine culture was positive in 30% cases. About 18% subjects showed positivity in more than 2 samples.

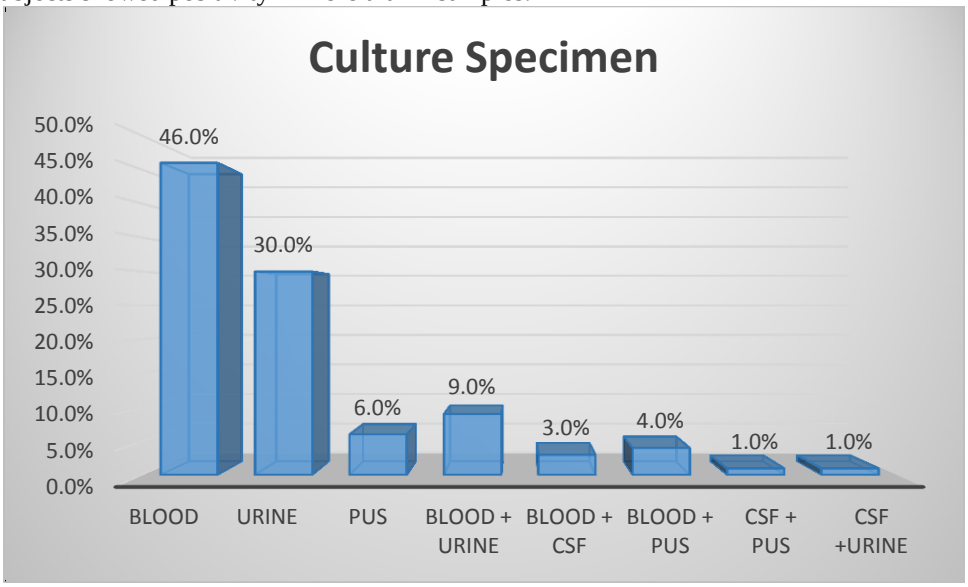

Table 9:-Distribution of subjects based on Type of organism isolated from culture

Organism	N	%
Klebsiella Pneumonia	30	30.0%
Escherichia coli	22	22.0%
Enterococcus species	12	12.0%
Staphylococcus aureus-MRSA	11	11.0%
Acinetobacter Baumanni	10	10.0%
Staphylococcus aureus	10	10.0%
Staphylococcus haemolyticus-CONS	7	7.0%
Pseudomonas aeruginosa	5	5.0%

Enterobacter Species	3	3.0%
Staphylococcus epidermiis-CONS	3	3.0%
Burholderia cepacia	2	2.0%
Coagulase Negative staphylococcus- CONS	2	2.0%
Klebsiella Pneumonia-ESBL	2	2.0%
Aerococcus viridans	1	1.0%
Citrobacter Species	1	1.0%
Proteus Mirabilis	1	1.0%
Staphylococcus hominis-CONS	1	1.0%

Most common organism isolated was K. Pneumonia (30%) followed by E. Coli (22%), Enterococcus species (12%), MRSA (11%), Acinetobacter Baumanni (10%) and staph. Aureus (10%). Other organisms isolated were CONS group (13%), Pseudomonas (5%), Enterobacter (3%), Burholderia cepaciae (2%), ESBL Klebsiella Pneumonia (2%), Aerococcus viridans (1%), Citrobacter (1%) and Proteus mirabilis (1%).

Table 10:-Distribution of subjects based on type of organism isolated from various specimens

Organism	**Blood**	**CSF**	**Pus**	**Urine**	**Total**
Klebsiella Pneumonia	18	1	1	10	30
Escherichia coli	4	0	1	17	22
CONS	10	2	0	1	13
Enterococcus species	2	0	0	10	12
Staphylococcus aureus-MRSA	6	0	4	1	11
Acinetobacter Baumanni	7	1	1	1	10
Staphylococcus aureus	5	1	4	0	10
Pseudomonas aeruginosa	5	0	0	0	5
Enterobacter Species	2	0	0	1	3
Burholderia cepacia	2	0	0	0	2
Klebsiella Pneumonia-ESBL	2	0	0	0	2
Aerococcus viridans	1	0	0	0	1
Citrobacter Species	1	0	0	0	1
Proteus Mirabilis	0	0	0	1	1
Total	65	5	11	42	123

Most common organism isolate form blood culture was Klebsiella followed by CONS and from that of Pus was Staph. Aureus. E. coli was most common from urine while CONS group of organism was found in 2 out of 5 specimen of CSF.

Table 11:-Antibiotic sensitivity pattern of Klebsiella Pneumonia

Klebsiella Pneumonia (n-30)				
Antibiotic Pattern	**R**	**S**	**I**	**Total**
Ampicillin	25			27
Penicillin	27			6
Pip+Tazo	19	9	1	25
Amox+Clav	22	3	2	27
Ertapenem	1	5		4
Amikacin	13	12		26
Gentamycin	20	7		23
Netilmycin	1	1	2	22
Cetriaxone	26			15
Cefotaxime	23			24
Cefuroxime	22			19
Cefoperazone	10	5		23
Cefepime	23	1		18
Nalidixic Acid	6	13		29

Ciproflox	4	17	2	29
Nitrofurantoin	6	8	4	14
Imipenem	13	16		28
Meropenem	13	16		4
Tigecycline	1	13		4
trim+sulpha	14	14		0
Polymyxin B		4		0
Tobramycin	1	1	2	0

Klebsiella Pneumonia was most sensitive towards Ciprofloxacin, Imipenem and Meropenem while it is resistant towards beta lactum and Cephalosporin group of antibiotics.

Table 12:-Antibiotic sensitivity pattern of E. coli

E. Coli (n-22)				
Antibiotic Pattern	**R**	**S**	**I**	**Total**
Ampicillin	14			18
Penicillin	16	1		8
Pip+Tazo	4	16		1
Amox+Clav	12	4	2	1
Ertapenem		8		1
Tetracyclin	1			1
Teicoplanin		1		2
Vancomycin		1		19
Linezolid		1		17
Chloramphenicol		2		8
Amikacin	3	16		17
Gentamycin	8	9		14
Netilmycin	1	7		15
Cetriaxone	16	1		7
Cefotaxime	13	1		18
Cefuroxime	14	1		5
Cefoperazone	1	6		16
Cefepime	15	3		5
Nalidixic Acid	2	3		2
Ciproflox	7	9		13
Ofloxacin	2	3		18
Levoflox	2			18
Nitrofurantoin	4	8	1	14
Imipenem	2	16		7
Meropenem	2	16		1
Colistin		14		19
Tigecycline		7		5
Rifampicin		1		7
trim+sulpha	10	9		0
Polymyxin B		5		0
Tobramycin	2	5		0

E.coli was most sensitive towards Piperacillin-Tazobactum and Amikacin while mostly resistant towards beta lactum and cephalosporin group of antibiotics.

Table 13:-Antibiotic sensitivity pattern of CONS

CONS (n-13)				
Antibiotic Pattern	**R**	**S**	**I**	**Total**
Ampicillin	7			13
Penicillin	8			12
Tetracyclin	1	10		12

Teicoplanin	3	9	1	4
Vancomycin	2	10		1
Linezolid		12		10
Chloramphenicol		4		3
Amikacin	1			8
Gentamycin	3	6	1	3
Netilmycin		3		7
Ciproflox	6	2		6
Ofloxacin	2	1		6
Levoflox	3	2	2	13
Nitrofurantoin	1	5		11
Tigecycline		6		8
Rifampicin	3	10		0
trim+sulpha	5	6		0
Clindamycin	6	2		0

CONS group of organism were sensitive towards tetracycline, Vancomycin, linezolid, Rifampicin and Teicoplanin while they were resistant towards beta lactums, Ciprofloxacin and Clindamycin.

Table 14:-Antibiotic sensitivity pattern of Enterococcus

Enterococcus (n-12)				
Antibiotic Pattern	**R**	**S**	**I**	**Total**
Ampicillin	7			12
Penicillin	9	2		12
Tetracyclin	6	3		12
Teicoplanin		12		8
Vancomycin		12		10
Linezolid	1	11		1
Chloramphenicol		8		9
Gentamycin	7	3		1
Netilmycin	1			10
Ciproflox	8	1		11
Ofloxacin	1			1
Levoflox	8	2		4
Nitrofurantoin	3	7	1	7
Colistin		1		5
Tigecycline		4		0
Rifampicin	4	3		0
Clindamycin	5			0

Enterococcus species were mostly sensitive towards Teicoplanin, Vancomycin, Linezolid and Nitrofurantoin while it is resistant towards beta lactum, Fluroquinolones and Gentamycin.

Table 15:-Antibiotic sensitivity pattern of Acinetobacter Baumanni

Acinetobacter Baumanni (n-10)				
Antibiotic Pattern	**R**	**S**	**I**	**Total**
Amikacin	3	1		10
Gentamycin	8		2	9
Netilmycin		1		9
Cetriaxone	10			7
Cefotaxime	9			5
Cefuroxime	9			5
Cefoperazone	7			9
Cefepime	5			1
Nalidixic Acid	5			5
Ciproflox	9			10

Ofloxacin	1			10
Nitrofurantoin	5			10
Imipenem	9	1		8
Meropenem	9	1		2
Colistin		10		1
Tigecycline		8		0
trim+sulpha		2		0
Tobramycin		1		0

All the cases of Acinetobacter Baumanni were sensitive to Colistin while 80% were sensitive to Tigecycline while it is resistant towards most other groups of antibiotics.

Table 16;-Antibiotic sensitivity pattern of Staph. Aureus

S. Aureus (n-10)				
Antibiotic Pattern	**R**	**S**	**I**	**Total**
Ampicillin	7			10
Penicillin	7			10
Tetracyclin		10		9
Teicoplanin		10		6
Vancomycin		10		9
Linezolid		9		3
Chloramphenicol	1	5		1
Gentamycin	4	5		1
Netilmycin		3		1
Cetriaxone		1		9
Cefotaxime		1		1
Cefuroxime		1		8
Ciproflox	5	4		3
Ofloxacin	1			6
Levoflox	1	5	2	9
Nitrofurantoin		3		10
Tigecycline		6		9
Rifampicin		9		0
trim+sulpha	6	4		0
Clindamycin	2	7		0

All the cases of Staph. Aureus were sensitive towards Tetracycline, Teicoplanin and Vancomycin while 90% were sensitive towards Linezolid and Rifampicin. About 70% of these organisms were resistant to beta lactums.

Table 17:-Antibiotic sensitivity pattern of Methicillin resistant Staph. Aureus

MRSA (n-11)				
Antibiotic Pattern	**R**	**S**	**I**	**Total**
Ampicillin	8			11
Penicillin	10			10
Pip+Tazo	1			11
Tetracyclin	1	10		10
Teicoplanin		10		7
Vancomycin		11		1
Linezolid		10		7
Chloramphenicol		7		2
Amikacin	1			1
Gentamycin	1	6		1
Netilmycin	0	2		1
Cetriaxone		1		1
Cefotaxime		1		7
Cefepime	1			6

Nalidixic Acid		1		2
Ciproflox	5	2		6
Levoflox	2	2	2	9
Tigecycline		2		5
Rifampicin	1	5		0
trim+sulpha	4	5		0
Clindamycin	3	2		0

Most of the cases of MRSA were sensitive towards Tetracycline, Teicoplanin, Linezolid and Vancomycin while most of these were resistant to beta lactums.

Table 18:-Antibiotic sensitivity pattern of Pseudomonas Aeruginosa

P. Aeruginosa (n-5)				
Antibiotic Pattern	**R**	**S**	**I**	**Total**
Ampicillin	3			3
Penicillin	3			5
Pip+Tazo	1	2	1	5
Amox+Clav	3			4
Amikacin	1	4		2
Gentamycin	3	2		2
Cetriaxone	4			4
Cefotaxime	2			4
Cefuroxime	2			3
Cefoperazone	2	1	1	5
Cefepime	1	3		2
Nalidixic Acid	3			2
Ciproflox	3	2		5
Levoflox	1	1		5
Nitrofurantoin	2	0		4
Imipenem	1	4		3
Meropenem	1	3	1	3
Colistin		4		0
Tigecycline	2	1		0
trim+sulpha	3			0

Over half of the cases of P. Aeruginosa were sensitive to Amikacin, Imipenem, Meropenem and Colistin. While maximum resistant was seen to beta lactams, Ceftriaxone, ciprofloxacin and Nalidixic acid.

Table 19:-Antibiotic sensitivity pattern of Enterobacter Species

Enterobacter Species (n-3)				
Antibiotic Pattern	**R**	**S**	**I**	**Total**
Ampicillin	2			2
Penicillin	2			2
Pip+Tazo	1	2		2
Amox+Clav	2			2
Amikacin		2		2
Gentamycin	1	1		3
Cetriaxone	1	1		1
Cefotaxime	2			3
Cefuroxime	3			1
Cefoperazone		1		2
Cefepime	1	2		3
Nalidixic Acid		1		3
Ciproflox	1	1		3
Imipenem		3		2
Meropenem		3		2

Colistin		3		1
Tigecycline		2		0
trim+sulpha	1	1		0
Polymyxin B		1		0

All the cases of Enterobacter species were sensitive to Imipenem, Meropenem and Colistin while all are resistant to Cefuroxime.

Table 20:-Antibiotic sensitivity pattern of Burholderia cepacia

Burholderia cepacia (n-2)				
Antibiotic Pattern	**R**	**S**	**I**	**Total**
Ampicillin	2			2
Penicillin	2			2
Pip+Tazo	2			2
Amox+Clav	2			2
Amikacin	2			1
Gentamycin	2			1
Cetriaxone	1	1		2
Cefotaxime	1			1
Cefuroxime	1			2
Cefoperazone	1		1	2
Cefepime	1			1
Nalidixic Acid	2			2
Ciproflox	2			2
Levoflox	1			2
Imipenem	1		1	0
Meropenem		1	1	0
trim+sulpha	1	1		0

Burholderia cepaciae were seen to be resistant towards most of the groups of antibiotics while 1 out of 2 cases were sensitive towards ceftriaxone, Meropenem and Trimethoprim + Sulphamethoxazole.

Table 21:-Antibiotic sensitivity pattern of Extended-spectrum beta-lactamases producing (ESBL) Klebsiella Pneumonia

Klebsiella Pneumonia-ESBL (n-2)				
Antibiotic Pattern	**R**	**S**	**I**	**Total**
Ampicillin	2			2
Penicillin	2			2
Pip+Tazo		2		2
Amox+Clav	1	1		2
Ertapenem		2		1
Amikacin		2		2
Gentamycin	1	1		2
Netilmycin		1		2
Cetriaxone	2			2
Cefotaxime	2			2
Cefuroxime	2			1
Cefepime	1	1		1
Ciproflox		2		2
Levoflox		1		2
Nitrofurantoin			1	2
Imipenem		2		2
Meropenem		2		2
Colistin		2		1
Tigecycline		2		0
trim+sulpha	1	1		0

Tobramycin		1		0

Two cases of extended-spectrum beta-lactamases producing (ESBL) Klebsiella Pneumonia were sensitive towards Piperacillin-Tazobactum, Amikacin, Ciprofloxacin, Imipenem, Meropenem, Colistin and Tigecycline while both were resistant to beta lactum and Cephalosporin's.

Table 22:-Antibiotic sensitivity pattern of Aerococcus viridans

Aerococcus viridans (n-1)				
Antibiotic Pattern	**R**	**S**	**I**	**Total**
Penicillin	1			1
Tetracyclin		1		1
Teicoplanin		1		1
Vancomycin		1		1
Linezolid		1		1
Chloramphenicol		1		1
Gentamycin		1		1
Netilmycin		1		1
Levoflox		1		0
Rifampicin		1		0
trim+sulpha	1			0

One case of Aerococcus viridans was resistant to Penicillin and Trimethoprim+ Sulphamethoxazole while it was resistant to all other tested drugs.

Table 23:-Antibiotic sensitivity pattern of Citrobacter Species

Citrobacter Species (n-1)				
Antibiotic Pattern	**R**	**S**	**I**	**Total**
Pip+Tazo		1		1
Amox+Clav	1			1
Chloramphenicol		1		1
Amikacin	1			1
Gentamycin	1			1
Netilmycin	1			1
Cefotaxime		1		1
Cefuroxime	1			1
Cefepime		1		1
Ciproflox		1		1
Imipenem		1		0
Meropenem		1		0
trim+sulpha		1		0

One case of Citrobacter species was sensitive to Piperacillin-Tazobactum, Chloramphenicol, Cefotaxime, Cefipime, Ciprofloxacin, Imipenem and Meropenem and Trimethoprim-Sulphamethoxazole.

Table 24:-Antibiotic sensitivity pattern of Proteus Mirabilis

Proteus Mirabilis (n-1)				
Antibiotic Pattern	**R**	**S**	**I**	**Total**
Pip+Tazo		1		1
Amox+Clav		1		1
Amikacin		1		1
Gentamycin			1	1
Cetriaxone	1			1
Cefuroxime	1			1
Cefepime	1			1
Nalidixic Acid	1			1
Ciproflox	1			1
Nitrofurantoin	1			1

Imipenem		1		1
Meropenem		1		1
Colistin	1			0
Tigecycline	1			0
Polymyxin B	1			0

One case of Proteus Mirabilis was sensitive to Piperacillin-Tazobactum, Amoxicillin-clavulunate, Amikacin, Imipenem and Meropenem.

Discussion:-

Sepsis is one of the most common causes of neonatal hospital admissions [2-4] and is estimated to cause 26% of all neonatal deaths worldwide [5]. Late onset sepsis usually presents after 72 hours of age. The source of infection is either nosocomial or community-acquired and neonates usually present with septicemia, pneumonia or meningitis [1]. Nosocomial sepsis frequency and microorganism profiles vary widely from center to center and from country to country [32].

In present study, out of the total 1473 admitted in NICU during study period, 100 cases were observed to be culture positive. So, the overall incidence of sepsis in neonates admitted in the NICU was reported as 6.7%. In a similar study by Resende et al. in Brazil, out of 551 neonates admitted in the NICU during the study period, 112 neonates developed sepsis (20.3%) [33]. Our results were also similar to the rates reported in developing countries [34,35].

Demography

Out of the 100 babies with late onset Culture Positive Sepsis, 69% were males while 31% were females.

Male predominance was also noted in a similar study by Nayak et al., where out of 195 suspected cases of neonatal sepsis, 121 (62.05%) male and 74 (37.95%) were female neonates, with the male to female ratio of 1.63:1 [96]. Jyothi P et al. noted were 65.5% males and 34.5% females in their study with male to female ration of 1.9:1 [89]. Male to female ratio was noted as 2.5:1 by Shah et al. [30]. In a similar study by Vaniya et al., out of the 713 patients with neonatal sepsis, 449 (62.97%) were male and 264 (37.03%) were female subjects [27]. Sawhney et al. observed the prevalence of Male to female prevalence as 59.5% and 40.5% [25].

Thus our results are similar to the previous studies carried out by various authors who hypothesized that incidence of septicemia was higher in males ranging from 59%-82% due to the presence of factors regulating the synthesis of gamma globulin on X chromosome [36]. This may also be due to a gender bias in presentation to hospital prevalent in our community.

Organism Isolated

In present study most common organisms isolated were K. Pneumonia (30%) followed by E. Coli (22%), Staph. Aureus (21% including MRSA 11%), Enterococcus species (12%) and Acinetobacter Baumanni (10%). Other organisms isolated were CONS group (13%), Pseudomonas (5%), Enterobacter (3%), Burholderia cepaciae (2%), ESBL Klebsiella Pneumonia (2%), Aerococcus viridans (1%), Citrobacter (1%) and Proteus mirabilis (1%).

Thus in present study, gram-negative bacteria were the principle pathogens, which caused septicemia. Similar results were reported by Roy et al. and Jain A et al. [37,38]. Similar preponderance of the gram-negative rods has been reported in other studies conducted in India [25,27-30].

In a study by Gupta et al. Klebsiella pneumonia and Escherichia coli were the commonest isolates in 42.30% and 38.46% of cases, respectively [26]. In a study by Sawhney et al., Klebsiella spp has been found to be the predominant pathogen (45.75%) of the culture positive cases followed by staphylococcus aureus (25.7%). Vaniya et al. found that common isolates in neonatal sepsis were Klebsiella, Staphylococcus aureus, and coagulase-negative Staphylococci [27]. Pooja R also observed that Klebsiella spp. were the most common pathogens followed by S.aureus [28]. Klebsiella pneumoniae (30.66%) was the most common organism isolated in another similar study by Nayak et al [29]. Klebsiella pneumoniae (41%) and Coagulase Negative Staphylococcus (31.32%) were the common organisms isolated in a study by Bhurle teet al. [31].

Klebsiella and Staphylococcus aureus can survive in the environment for a relatively long time and fairly widely distributed in the hospital environment, and, therefore, have the potential for being transmitted from the environment

to the patients through practices that breach infection control measures. This emphasizes the need for the establishment of effective and functional infection control programs in hospitals [30].

Antibiotic Sensitivity Pattern

Klebsiella Pneumonia was most sensitive towards Ciprofloxacin, Imipenem and Meropenem while it is resistant towards beta lactum and cephalosporin group of antibiotics. In a similar study by Nayak et al. almost 80% of the Klebsiella isolates were resistant to commonly used antibiotics, especially gentamicin and the second and third generation cephalosporin's. Antibiotic sensitivity testing showed high resistance to multiple drugs while imipenem is still the best for infections with multidrug-resistant organism [29]. Similarly in a study by Jyothi et al., highest sensitivity by K. pneumonia was shown towards Imipenem [22]. In another study by Vaniya et al. Klebsiella Pneumonia was most sensitive towards ciprofloxacin and Gatifloxacin while it is resistant towards beta lactum and cephalosporin group of antibiotics [27]. Sawhney et al. observed Klebsiella Pneumonia to be most sensitive towards Cotrimoxazole, Gentamycin and ciprofloxacin while almost all organisms were resistant towards beta lactum and cephalosporin group of antibiotics [25].

In present study, E.coli was most sensitive towards Amikacin and Piperacillin-Tazobactum while mostly resistant towards Ampicillin / Amoxicillin and cephalosporin group of antibiotics. In a study by Nayak et al. two third of the E.coli isolates were resistant to Ampicillin [29]. Shah et al. observed E.Coli to be maximally sensitive towards Amikacin and maximum resistance was towards Cephalosporin [30]. Vaniya et al. observed E.coli isolates to be Fluroquinolones and chloramphenicol and resistant towards Cephalosporin [27].

In present study, all the cases of Staph. Aureus were sensitive towards Tetracycline, Teicoplanin and Vancomycin while 90% were sensitive towards Linezolid and Rifampicin. About 70% of these organisms were resistant to beta lactums. Most of the cases of MRSA were sensitive towards Tetracycline, Teicoplanin, Linezolid and Vancomycin while most of these were resistant to beta lactums. Similar results were also observed in the studies done by Shrestha et al.[20] and Rahman et al.[39] Our results also matched the reports of Narang A et al., where most of the S. aureus isolates responded very well to Vancomycin [38]. Shah et al. observed maximum resistant towards Cephalosporin and Nalidixic acid [30]. Vaniya et al. observed over 90% sensitivity towards Linezolid while more than 80% resistance was observed for beta lactums [27]. Sawhney et al. observed 84% resistance towards Amoxicillin and 100% sensitivity towards Vancomycin [25].

The clinical significance of relatively low virulence isolates, such as CONS is difficult to ascertain. These organisms can cause true bacteremia or their isolation may represent simple contamination. It would be unfair to ignore such isolates as contaminants. In present study, CONS group of organism were sensitive towards Tetracycline, Vancomycin, Linezolid, Rifampicin and Teicoplanin while they were resistant towards beta lactums, Ciprofloxacin and clindamycin. Sawhney et al. observed 100% resistant towards Amoxicillin among CONS isolates [25]. Vaniya et al. observed maximum sensitivity of CONS towards Levofloxacin, Linezolid and gentamycin. Shah et al. in a similar study, observed maximum resistant among CONS for Clindamycin, ciprofloxacin and Nalidixic acid [30].

Enterococcus species were mostly sensitive towards Teicoplanin, Vancomycin, Linezolid and Nitrofurantoin while it is resistant towards beta lactum, Fluroquinolones and gentamycin. Similar pattern of resistance was noted in the study by Vaniya et al. and Jyothi et al [22].

All the cases of Acinetobacter Baumanni were sensitive to Colistin while 80% were sensitive to Tigecycline while it is resistant towards most other groups of antibiotics. Similar pattern of high resistant to most antibiotics in Acinetobacter species was observed by Nayak et al [29]. A similar observation was also made by Vaniya et al. where Acinetobacter species showed good sensitivity only to Gatifloxacin while they were resistant to all other antibiotics [27].

In present study, over half of the cases of P. Aeruginosa were sensitive to Amikacin, Imipenem, Meropenem and Colistin. While maximum resistant was seen to beta lactums, Ceftriaxone, Ciprofloxacin and Nalidixic acid. Shah et al. observed maximum resistance of pseudomonas isolates towards Cephalosporins, Nalidixic acid and chloramphenicol while maximum sensitivity was observed towards Amikacin [30]. Vaniya et al. also observed poor sensitivity towards cephalosporins and beta lactums with maximum sensitivity towards Gatifloxacin [27]. In the studies done by Bhat et al. [40] and Aletayeb et al. [41] Pseudomonas sp. were the most sensitive to aminoglycoside antibiotics such as amikacin and gentamicin.

Thus present study observed a decreased sensitivity of microorganisms to the commonly used drugs such as ampicillin, amoxicillin and aminoglycosides. Sensitivity of gram-negative and gram positive organisms to the third generation cephalosporins was quite high, which is of great concern. Sensitivity to higher antibiotics like linezolid and Carbapenems was much higher than that to other antibiotics, but it should not be used indiscriminately and be kept as a reserve drug; otherwise, resistance to even these drugs may develop soon, thereby limiting our treatment options. Sensitivity pattern of ciprofloxacin and other fluoroquinolones was also promising. In neonatology, the use of ciprofloxacin in life-threatening infections, although rare, is justified by the fact that clinical benefits largely overweight the potential risks. The various studies indicate a gradual increase in the emergence of antibiotics-resistant organisms. However, many factors play a role in the development of resistance such as no uniformity in the usage of antibiotics, indiscriminate use, and availability of antibiotics. Antibiogram may vary depending on the study group and the hospital setup. So, it is highly recommended that antibiotics should be used depending on the antibiotic sensitivity pattern of the isolates.

Conclusions:-

This study indicated that Klebsiella, E.coli and Staphylococcus aureus species remain the principal organisms causing neonatal sepsis. Many multi-drug-resistant organisms were isolated from neonatal septicemia. Therefore, great caution is required in selection of antibiotics. We thus recommend that resistance pattern of the organisms should be considered essential for deciding the empirical treatment. Prompt treatment of neonatal sepsis with judicious use of appropriate antibiotics can minimize the morbidity and mortality, besides reducing the emergence of multidrug resistant organisms in NICU.

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