BACTERIOLOGY OF NEONATAL SEPTICAEMIA AND BACTERAEMIA AT THE KENYATTA NATIONAL HOSPITAL

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A Thesis submitted in part fulfilment for the degree of Master of Medicine (paediatrics) at the University of Nairobi. \ 1981..'

This Dissertation is my original work and has not been published or presented for a degree in any other Universit

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SUMMARY

Bacterial growth was obtained from 114 neonates from all the paediatric units of the Kenyatta National Hospital (K.N.H.) where neonates are admitted and managed during the period January to December, 1980.

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The positive bacterial blood cultures of the 114 neonates were Staphylococcus albus in 35 cases (29. 7%, Staphylococcus aureus in 24 cases (20. 3%, Escherichia coli in 21 cases (17. 8%), Klebsiella in 17 cases (14.4%), Streptococcus faecalis in 7 cases (5. 9%), Proteus in 4 cases (3. 4%), Citrobacter and Acinetobacter in 3 cases (2. 5%) each, Streptococcus viridans in 2 cases (1.7%) and Alkaligines faecalis and Enterobacter in 1 case (0. 8%) each. A mixed growth of 2 microorganisms was obtained from 4 blood specimens.

Staphylococcus albus was 71.4% sensitive to cotrimoxazole, 65.7% sensitive to Lincomycin, 57. 1% sensitive to each of Erythromycin and Methicillin, 17. 2% sensitive to ampicillin and only 8. 6% sensitive to penicillin - G.

Staphylococcus aureus was 87. 5% sensitive to Lincomycin, 79. 2% sensitive to cotrimoxazole, 58. 3% sensitive to methicillin and 41, 7% sensitive to erythromycin. It showed 100% resistance to btoh ampicillin and penicillin - G.

Sensitivity to Gentamycin and Kanamycin was not rested for both Staph albus and Staph aureus.

Escherichia coli was 100% sensitive to gentamycin, 82.4% to cotrimoxazole, 64, 7% sensitive to kanamycin and 11, 8% sensitive to ampicillin.

Klebsiella. Was 100% sensitive to gentamycin, 82.4% sensitive to cotrirnoxazole, 64. 7% sensitive to kanamvcin and only 11. 8% sensitive to ampicillin.

From only one specimen proteus was recovered which was 100% resistant to both gentamycin and kanamycin but 100% sensitive to cotrirnoxazole.

INTRODUCTION AND REVIEW OF LITERAL LIRE

Septicaemia in the neonatal infant refers to generalised bacterial infection documented by a positive blood culture in the first 4 weeks of life (I), Early diagnostic features of septicaemia in the newborn and especially in the premature infant are nebulous and neonatal septicaemia has a high case fatality rate without treatment (2). With presently available antimicrobial agents most cases can at least theoretically be treated successfully. Treatment has therefore to be initiated on suspicion of infection and before the responsible microorganism has been identified. Generally bactericidal antibiotics are preferable to bacteriostatic ones as the neonate has a decreased ability to overcome infection both at the cellular and humoral level (1, 2).

The incidence of neonatal septicaemia has remained fairly constant over the past 40 years and varies from 1 per 1000 to 1 in 1600 live births (3), The mortality rate of neonatal septicaemia prior to 1937 was about 90% (4). The figure has fallen since the advent of antibiotics and has ranged between 13 to 45 per cent in recent series (3). Since the management of neonatal septicaemia does not vary significantly amongst most hospitals the difference in aetiologic agents and host factors probably account for the major differences in mortality rates.

A neonate may acquire an infection before it is born, during birth or thereafter during the neonatal period. Maternal infection prior to delivery places the neonate at an increased risk of infection.

Pre-eclampsia and chronic cardiovascular and renal disease also increase the risk of foetal and newborn infection. The mechanism is not known but is thought to be associated with foetal malnourishment secondary to poor placental blood supply (3).

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Bacterial transplacental infection is an uncommon event- Three organism are presumed to cross the placenta and infect the foetus namely Listeria monocytogenes, Campylobacter and Treponema pallidum (5). Ascending infections by organisms colonizing the maternal genital tract occurs considerably more frequently than transplacental spread (6). To reach the amniotic fluid from which it may be swallowed or aspirated a bacterium must traverse the cervical mucous plug, the decidua capsularis, the chorion and the amnion. At term however, in the region of the internal OS, the decidua is absent and the amnion and chorion are markedly atrophic providing perhaps a less-effective barrier to bacterial invasion than earlier in gestation (3). Blanc (6) has reported data that show excellent correlation between vaginal flora, bacteria recovered from infected amniotic sacs, and those bacteriae responsible for infection of the neonate. He has also demonstrated a progressive increase in the rate of recovery of bacteria from amniotic cavity with increasing duration of memberane rupture.

Bacterial infection of the foetus is associated most commonly with passage through the birth canal. Here the usually sterile foetus encounters maternal viginal, perineal, faecal and skin flora and many factors related to initial colonization are still not understood (3, 7). It has however been demonstrated that dense pharyngeal colonization, high umbilical colonization density as well as

colonization by gram-negative organisms are associated with increased incidence of sepsis and septicaemia in the neonate (7).

The neonate may also acquire infection from manipulative procedures such as umbilical vein, catheterization, intubation as well as contaminated water in incubators and intravenous fluids in which gram negative bacilli may grow (8). Members of staff and mothers who handle the newborn may also act as sources of infection.

Once infected the neonate has decreased ability to overcome infection both at the cellular and humoral level (2). Although foetal plasma cells start synthesising lgG antibodies at approximately 12-20 weeks gestation, the bulk of lgG antibody in neonatal blood is thought to be of maternal origin (9). Maternal lgG antibody is the only immunoglobullin that crosses the placenta and has been demonstrated in foetal tissues as early as 38 days of gestation, lgG levels remain low during the first and second trimesters but increase rapidly during the third trimester and. at birth may exceed levels in the mother (9).

IgA antibodies do not cross the placenta and are undetectable in cord blood. Serum IgA. antibodies become detectable several weeks after birth (2, 9).

Complement is a general term for a series of nine serum proteins responsible for many aspects of inflammation and bacteriolysis. Several components of the complement system formed during activation of the complement pathway aid in the process of chemotaxis and opsonization (the preparation of bacteria for ingestion by phagoc}'tes) (10). The fourth complement protein to be activated C3 is cleaved into 2 unequal fragments, the larger of which C3b is an important opsonin. The rate of bacterial phagocytosis is proportional to serum levels of C3 and the neonate is relatively deficient in C3 (about *50% of* adult levels (10, 11). Leucocytes from neonates are able to phagocytose and kill baceria when placed in normal adult plasma, but the same leucocytes process the bacteria poorly if placed in plasma from neonates of low birth weight (11). The defect would appear to be in the lack of specific antibody and deficient alternative complement pathway components which are necessary for the opsonization of bacteria and in particular gram negative bacilli.

A wide variety of microorganisms cause septicaemia in the neonate and currently bacterial implicated in newborn infections are more usually gram negative organisms arising from the gastrointestinal tract as well as the "water-bugs" Pseudomonas and Klebsiella and many of thes are resistant with increasing frequency to most antibiotics (2, 13). The identity of the responsible microorganism may very occasionally be known but often the doctor has to make an educated guess, and has

therefore to keep continually informed on infecting microorganisms and their antibiotic sensitivity pattern in his hospital.

Medical Literature usually provides some information on predominant organisms in some hospitals but each hospital must publish the antibiotic sensitivity pattern of microorganisms cultured in the hospital regularly. It is hoped therefore that the results of this study will throw some light on the pattern of microorganisms causing infection in the neonates and their antibiotic sensitivity pattern at the Kenyatta National Hospital. To my knowledge this is the first compilation of the pattern of neonatal infection in this hospital.

AIMS AND OBJECTIVES

To analyse all the positive blood cultures obtained from nronates at the Kenyatta National Hospital (K.N.H.) for the period January 1st to December 31st 1980 and find out:-

1. The total number of positive blood cultures, the overall pattern of microorganisms obtained and the distribution of the positive blood cultures in terms of the various units of the Kenyatta National Hospital where neonates are usually admitted and managed.

   The Maternity Nursery Unit

   The Paediatric inpatient wards 1 and 2

   The Paediatric Observation ward (P.O. W.)

2. The age and sex distribution of the neonates from whom positive blood cultures were obtained and establish the relationship if any, between the age of the neonate at the time the blood was taken for culture and the microorganism recovered

3. The antibiotic sensitivity pattern of all the microorganisms obtained to locally available antibiotics to which sensitivity is routinely tested, and compare any similarities or differences in this sensitivity of the microorganisms recovered from the three units in 1 above.

MATERIALS AND> METHODS

This is a retrospective study in which case records of all neonates admitted into the Kenyatta National Hospital (K.N.H.) Paediatric Wards, the Paediatric Observation Ward (P.O. W.) and the Maternity Nursery for the period January 1st to December 31st 1980 were examined. Any neonate in whose case records there was a positive blood culture report, was included into the study.

In those cases where blood had been submitted for culture and sensitivity but the bacteriological report was missing from the case records it was possible to trace the report in the Bacteriology Department filing room using the date the blood was submitted and the neonates name and inpatient number.

For each neonate from whom a positive blood culture was obtained the following information was extracted and recorded on a separate piece of paper designed for subsequent analysis.

(a) personal details - name, inpatient number, sex and age at the time blood was taken and submitted for culture.
The unit where the neonate was admitted.

(b) The organism(s) recovered from the neonates blood and the antibiotic sensitivity pattern of the microorganisms to locally available and tested antibiotics.

The usual practice in this hospital is that blood for culture and sensitivity is submitted to the laboratory in nutrient broth which is incubated at 37°C for 12-24 hours before si '^cultures are done on both chocolate agar and McKonkey medium. Later identification of the microorganism and its antibiotic sensitivity test is dene and reported. Usually most specimens reach the laboratory within three hours after they are collected since specimens are collected from all the wards at 3 hourly intervals during the daytime. Those specimens that are taken during the night are sent to the routine laboratory, that functions for 24 hours, where again they are incubated overnight and transferred to the Department of Microbiology for subcultures the following day.

The blood is normally collected by a doctor from a peripheral vein after cleaning the skin with a spirit swab, and a different sterile needle is used to inject the blood into the bottle containing the nutrient broth. In some cases especially those neonates with neonatal jaundice who required exchange transfusion blood was collected from the umbilical vein during this procedure.

RESULTS

During the period of study, January to December 1980, a total of 3010 specimens were submitted from the whole of the Kenyatta National Hospital to the Department of Microbiology for culture and sensitivity. Out of these a bacterial growth was obtained from 318 (10. 6%) of which 114 were specimens from the neonatal age group (i. e. babies 28 days old or younger) and are the subject of the study.

A mixed growth of 2 species of microorganisms were obtained from 4 blood specimens making the total frequency of recovery of microorganisms 118. The neonates came from the 3 units of the Kenyatta National Hospital where neonates are admitted and managed as shown in Table I below.

TABLE I: Distribution of the study group of neonates from the three paediatric units at Kenyatta National Hospital.

Maternity Nursery	47	41.3%
Paediatric Wards	55	48.2%
Paediatric Observation Wards	12	10.5%

The neonates managed in the Nursery are usually delivered in the hospital maternity unit whilst those managed in the 2 other units are born outside the hospital and are later admitted into the hospital

when taken ill. For further analysis the latter two groups are treated together since they have this feature in common and the figures for the paediatric observation ward are too small for separate analysis.

SEX DISTRIBUTION

Of the 114 neonates 65 (57%) were males and 49 (43%) were females. From the three units males outnumbered females as shown in Table II.

TABLE II: Sex distribution of neonates from whose blood bacterial growth was obtained at the Kenyatta National Hospital,

UNIT	MALE	FEMALE	TOTAL
MATERNITY NURSERY	26	21	47
PAEDIATRIC INPATIENT WARDS	31	24	55
PAEDIATRIC OBSERVATION WARDS	S	4	12
TOTAL:	65	49	114

AGE DISTRIBUTION

Of the 114 neonates 64 (56. 1%) were 7 days old or less. 86 (75. 4%) were 14 days old or less and only 3 babies were more than 21 days old at the time blood was taken and submitted for culture and sensitivity.

3 babies from the Maternity Nursery Unit had a positive blood culture from blood taken on the first day of life and 6 babies were 2 days old.

No baby from the paediatric wards or the paediatric observation ward was less than 4 days old at the time blood was taken and submitted for culture and sensitivity.

TABLE III: Age distribution of the neonates who had positive blood cultures from all the 3 units.

AGE	NUMBER OF NEONATES	PERCENTAGE OF TOTAL
0 - 7 days	64	56. 1%
8 - 14 days	22	19. 3%
15 - 21 days	25	21.9%
22 - 28	3	2. 7%
	114	100%

FREQUENCIES OF RECOVERY OF MICROORGANISMS FROM ALL THE 3 UNITS

TABLE IV: Frequencies of all microorganisms recovered from alJ the 3 units of the Kenyatta National Hospital

MICROORGANISM	FREQUENCY OF RECOVERY	PERCENTAGE OF TOTAL
Staphylococcus albus	35	29. 7%
Staphylococcus aureus	24	20. 3%
Escherichia coli	21	17. 8%
Klebsiella	17	14.4%
Streptococcus faecalis	7	5. 9%
Proteus	4	3.4%
Citrobacter	3	2.6%
Acinetobacter	3	2. 6%
Streptococcus viridans	2	1•7%
Alkaligines faecalis	1	0. 8%
Enterobacter	1	0. 8%
Total	118	100%

The frequencies of the microorganisms are further divided into the two units i. e. maternity nursery and paediatric wards and paediatric observation ward for comparison.

TABLE V: Frequencies of microorganisms recovered from maternity nursery compared to frequencies of the same microorganisms from the wards and paediatric observation wards.

	MATERNITY NURSERY		PAEDIATRIC WARDS AND P.O. W.	
MICROORGANISM	FREQUENCY OF RECOVERY	PERCENTAGE	FREQUENCY	PERCENTAGE
Staphylococcus albus	10	20%	25	36. 8%
Staphylococcus aureus	11	22%	13	19.1%
Escherichia coli	14	28%	7	10. 3%
Klebsiella	8	16%	9	13.2%
Proteus	1	2%	3	4.4%
Citrobacter	0	o%	3	4. 4%
Streptococcus faecalis	4	8%	3	4-4%
Acinetobacter	1	2%	2	2. 9%
Streptococcus viridans	1	2%	1	1.5%
Alkaligines faecalis	0	o%	1	1.5%
Enterobacter	0	o%	1	1.5%
TOTAL:	50	100%	68	100%

ANTIBIOTIC SENSITIVITY PATTERNS OF THE MICROORGANISMS RECOVERED

1. STAPHYLOCOCCUS ALBUS: was recovered from 35 neonates and was tested for sensitivity to the set of antibiotics shown.

TABLE vi: Antibiotic sensitivity patter of Staph, albas recovered from all the neonates in the study group.

ANTIBIOTIC	NUMBER SENSITIVE	PERCENTAGE OF TOTAL TESTED
Cotrimoxazole	2.5	71.4%
Lincomycin	23	65.7%
Erythromycin	20	57. 1%
Methicillin	20	57. 1%
Sulphafurazole	11	31.4%
Tetracycline	8	22. 9%
Arnpicillin	6	17-2%
Penicillin - G	3	8.6%

NOTE: Staph, albus recovered from 2 specimens in the study group was resistant to all antibiotics tested above.

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COMPARISON OF ANTIBIOTIC SENSITIVITY PATTERN OF STAPH ALBUS RECOVERED FROM THE MATERNITY NURSERY AND THAT RECOVERED FROM THE PAEDIATRIC WARDS AND THE PAEDIATRIC OBSERVATION WARD

From the Maternity Nursery Staph aibus was recovered from 10 neonates and from 25 neonates from the other 2 units.

TABLE vn Antibiotic Sensitivity pattern of staph albus recovered from Nursery compared to staph albus recovered from paediatric wards and paediatric observation ward.

	MATERNITY NURSERY		PAEDIATRIC WARDS AND P.O. W.	
ANTIBIOTIC	NUMBER SENSITIVE	PERCENTAGE	NUMBER SENSITIVE	PERCENTAGE
Cotrimoxazole	6	60%	19	76%
Lincomycin	5	50%	18	72%
Erythromycin	4	40%	16	64%
Methicillin	4	40%	14	56%
Tetracycline	2	20%	10	40%
Sulphafurazole	1	10%	6	24%
Ampicillin	1	10%	3	12%
Penicillin - G	0	o%	3	12%

2. STAPHYLOCOCCUS AUREAUS: Staph, aureus was recovered from 24 specimens from the whole of the study group of which 13 were from the Paediatric Wards and P. O. W. and 11 from the Maternity Nursery. The overall antibiotic sensitivity pattern of staph, aureus is shown in the table below:

TABLE viii: Antibiotic sensitivity pattern of Staph aureus recovered from all the units.

ANTIBIOTIC	NUMBER SENSITIVE	PERCENTAGE
Lincomycin.	21	87. 5%
Cotrimoxazole	19	79. 2%
Methicillin	14	58. 3%
Sulphafurazole	14	58. 3%
Erythormycin	10	41.7%
Tet racycline	8	33. 3%
Ampicillin	0	o%
Penicillin - G	0	&7o

COMPARISON OF ANTIBIOTIC SENSITIVITY OF E. CPU FROM THE MATERNITY NURSERY AND THE PAEDIATRIC WARDS AND P.O.W.

From the Nursery E. coli was recovered from 14 neonates and from the wards and P. O. W. from 7 neonates.

TABLE XI: Antibiotic sensitivity patter of E. coli from the Maternity Nursery compared to that from the Paediatric wards and P. O. W.

	E. Coli From Maternity Nursery		E. coli from Wards and P. 0. W.	
ANTIBIOTIC-	NUMBER SENSITIVE	PERCENTAGE	NUMBER SENSITIVE	PERCENTAC."
Gentamycin	14	100%	7	100%
Cotrirnoxazole	11	78. 6%	7	100%
Chloramphenicol	6	42. 9%	7	100%
Kanamycin	5	35. 7%	7	100%
Streptomycin	1	7. 1%	6	85. 7%
Sulphafurazole	2	14, 3%	5	71.4%
Arnpicillin	3	21.4%	3	42 9-Z %
Tetracycline	1			

ANTIBIOTIC SENSITIVITY OF KLEBSIELLA FROM ALL THE UNITS

Klebsiella was recovered from 17 specimens from the study-group and its antibiotic sensitivity pattern is shown below,

TABLE xii: Antibiotic sensitivity pattern of Klebsiella recovered from all the units.

ANTIBIOTIC	NUMBER SENSITIVE	PERCENTAGE
Gentamycin	17	100%
Cotrimoxazole	14	82. 4%
Kanamycin	11	64.7%
Chloramphenicol	7	41.2%
Tetracycline	4	23.5%
Sulphafurazole	5	29.4%
Streptomycin	7	41.2%
Ampicillin	2	H.8%

COMPARISON OF ANTIBIOTIC SENSITIVITY PATTERN OF KLEBSIELLA FROM THE MATERNITY NURSERY AND THE WARDS AND P. O. W.

From the Maternity Nursery Klebsiella was recovered from 8 specimens and from the wards and P. O W from 9 specimens.

TABLE XIII: Antibiotic sensitivity pattern of Klebsiella from Maternity Nursery compared to that from the wards and P. 0. W

	Klebsiella from Maternity Nursery		Klebsiella from the Wards and P. 0 W.	
Antibiotic	NUMBER SENSITIVE	PERCENTAGE	NUMBER SENSITIVE	PERCENTAGI
Gentamycin	8	100%	9	100%
Cotrimoxazole	7	87. 5%	7	77. 8%
Kanamycin	3	37. 5%	8	88. 9%
Streptomycin	3	37. 5%	4	44.4%
Chloramphenicol	2	25%	5	55. 6%
Sulphafurazole	1	12. 5%	4	44.4%
Tetracycline	1	12. 5%	3	33, 3%
Ampicillin	o	o%	2	22. 2%.

ANTIBIOTIC SENSITIVITY PATTERNS OF OTHER MICROORGANISMS

STREPJTOCOCCUS FAECA LIS: Was recovered from 7 specimens and was 71. 4% sensitive to each of ampicillin and erythromycin and 14. 3% sensitive to ctorimoxazole. It was on the other hand 100% resistance to penicillin - G, tetracycline, lincomycin and methicillin,

PROTEUS: Was recovered from 4 specimens submitted from the study group. There was 100% sensitivity to cotrimoxazole and chloramphenicol. From one specimen it was resistant to both gentamycin and kanamycin.

CITROBACTER: Was 100% sensitive to kanamycin, gentamycin, cotrimoxazole and chloramphenicol and 100% resistant to ampicillin.

ACINETOBACTFR: Was recovered from 3 specimens and from one specimen it was sensitive to cotrimoxazole only and from the other 2 specimens it was sensitive to kanamycin, gentamycin and cotrimoxazole. There was 100% resistance to ampicillin and chloramphenicol.

STREP VIRIDANS: Was obtained from 2 specimens, showed sensitivity to both erythromycin and ampicillin and lincomycin. Both were resistant to ctrimoxazole, and penicillin - G. Only from one specimen was it sensitive to methicillin.

ALKALIGINES FAECA.LIS: Was obtained from one specimen and was sensitive to kanamycin and gentamycin only and resistant to ampicillin, cotrimoxazole and chloramphenicol.

DISCUSSION

.. The clinical manifestations of neonatal septicaemia are varied and quite subtle. To compound the clinicians dilemma, many signs of septicaemia overlap with those of conditions of v ~;ry different aetiology. For example, true apnoea may be the first sign of a septic insult. It may. however, also herald the onset of a severe metabolic disorder (e. g. hypoghycaemia), or be the warning sign of a serious C. N. S. . disorder, or be otherwise idiopathic (1, 3, 17). Since the clinical picture is so sufficiently vague readiness to perform diagnostic blood cultures in neonates who are [15] not doing well" is essential for early diagnosis.

The non-specificity and subtle nature of the presenting clinical picture results in antibiotics being given to many neonates in whom a diagnosis of sepsis is never confirmed. Aranda (14) while surveying drug utilization in a newborn intensive-care nursery in North America, found that 61. *9%* of all neonates admitted into the nursery received antibiotics, and that on average the number of drugs used per neonate was 3. 4. He has also estimated that a 1500 grn premature infant born in North America is exposed, to about 20 prescribed drugs between conception and discharge from the nursery.

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In the Kenyatta National Hospital nursery it is estimated that well over 50% of all preterm neonates are given antibiotics between the time of admission and discharge from the nursery, and that on any single day there are between 2 and 10 neonates on antibiotics on average (13), It is evident therefore that although only

47 neonates had positive blood cultures during the period of study, a large number of the neonates who received antibiotics had no bacteriological confirmation of septicaemia. The same probably holds true for neonates admitted into the Paediatric Wards and the Paediatric Observation Ward.

Although the incidence of neonatal septicaemia has not changed significantly since the advent of antibiotics the distribution of microorganisms causing neonatal septicaemia has changed considerably and varies from hospital to hospital. Dunham (4) in 1933 found that in neonatal septicaemia, streptococci were responsible for 38. 5% of cases, staphylococci 28. 2%, E. coli 25. 6% and other organisms 7. 7%. In the last 10 years bacteria© implicated in neonatal infections are usually the gram negative bacilli arising from the gastrointestinal tract, and the "water bugs" Pseudomonas and Klebsiella (2, 13).

The commonest organisms found in this study were Staph albus 29.7%, Staph aureus 20. 3%, E. coli 17.8%, Klebsiella 14. 4%, Strep faecalis 5. 9% and other microorganisms 11. 7%. Staphylococci were mainly recovered from older neonates from the wards and P.O. W. who had been delivered outside Kenvatta National Hospital and had at least spent some time in the community outside. About half of these neonates had neonatal jaundice with suspected septicaemia. Blood specimens from some of them submitted for culture and sensitivity were taken from the umbilical vein during exchange transfusion, and it is likely that some of these neonates did not have true septicaemia but transient bacteraemia following umbilical vein catheterization. Indeed several studies have demonstrated bacteraemia following umbilical vein catheterization in 5.-50% of neonates. It has also been demonstrated that the time of insertion of catheter and administration of antibiotics does not

significantly influence this phenomenon. The most common organisms recover* following this procedure are Staphylococci and Pseudomonas (15, 16). It is also likely that in some neonates in this study Staphylococci recovered represented contaminants from the skin.

The pattern of microorganisms recovered from the nursery is different from thos recovered from the wards and P. O. W. (This is clearly demonstrated in Table V. For example, from the nursery E coli was the commonest organism accounting for *28%* of cases while in the wards and P. O. V/. it only accounted for 10. 3% of cases. Staph albus on the other hand accounted for 20% of cases from the nursery and 36. 8% of cases from the wards and P.O. W. It is likely that the pattern of microorganisms from the nursery is a truer and closer representation of microorganisms that cause neonatal septicaemia in this hospital. From all the units males outnumbered females as demonstrated in table II on page 12 but the differences are not statistically significant.

Most of the neonates from whom positive blood cultures were obtained were 14 days old or younger as shown in table III. 56. 1% of the neonates were 7 days old or younger while 75. *4%* were 14 days old or younger. 3 babies from the nursery had a bacterial growth obtained from blood taken on the first day of life and this likely represents intrauterine infection and may have been associated with prolonged rupture of membranes. From the wards and P.O. W. no neonate was less than 4 days old at the time blood was taken and submitted for culture. It appears that neonates from the tursery are more prone to bacterial infection earlier in life. This may be partly explained by the

fact that a bigger percentage of neonates from the nursery were premature. Delay in recognition of symptoms at home may also have been a contributory factor, This being a retrospective study it was not possible to correlate birth weight and gestational age with the microorganisms recovered and the time of infection due to incompleteness of records.

Sta h albus. was recovered from 35 neonates and its highest antibiotic sensitivities was to cotrimoxazole (71.4%), licomycin (65. 7%, and erythromycin and methicillin (57. 1% for each). There was 17. 2% sensitivity to ampicillin and 8. 6% sensitivity to penicillin - G.

Staph albus recovered from the nursery was 100% resistant to penicillin - G and only 10% sensitive to ampicillin, and only 50% sensitive to lincomycin. From the wards and P. O. W. there was 72% sensitivity to lincomycin.

On the whole staph albus from the maternity nursery group of neonates was resistant with increasing frequencies to all the antibiotics tested. This is evident from tables VI and VII.

Staph aureus, was obtained from 24 neonates and was 100% resistant to both penicillin - G and ampicillin and was 58. 3% sensitive to methicillin. The highest sensitivity was to lincomycin (87. 5% and cotrimoxazole 79. 2%.

Again taken overall, staph aureus from the nursery was resistant with increasing frequencies to antibiotics tested in comparison with staph aureus from the wards and P.O. W. This is shown in tables VIII and IX.

Staphylococci in this study whether community acquired or hospital acquired appear to almost uniformly have the ability to produce penicillinase and are all resistant to penicillin - G„ Thus semi synthetic penicillinase - resistant penicillins (such as cloxacillin, oxacillin dicloxacillin or methicillin) or cephalosporins should be used as initial treatment for suspected cases of staphylococci septicaemia pending final antimicrobial testing.

E. coli. was cultured from 21 specimens (14 from Maternity Nursery 7 from the wards and P.O. W.). Overall there was 100% sensitivity to gentamycin but only 57. 1% sensitivity to kanamycin and 85. 7% sensitivity to cotrimoxazole and 61. 9% sensitivity to chloramphenicol.

A. significant difference from the 2 groups is that from the wards and P. O. W. there was 100% sensitivity to gentamycin, kanamycin, cotrimoxazole and chloramphenicol whilst from the Maternity Nursery the percentages were 100% 35.7%, 78. 6% and 42. 9% respectively. The lowest sensitivity of E. coli was to ampicillin (28. 6%). This is shown in tables X and XI on.

Klebsiella, recovered from 17 specimens showed 100% sensitivity to gentamycin and only 11. 8% sensitivity to ampicillin. Overall there was 64, 7% sensitivity to kanamycin (37. 5% from Maternity Nursery and 88. 9% from the wards and P. O. W.). From tables XII and XIII it is clear that klebsiella from the Maternity Nursery had increased resistan to all the antibiotics tested except gentamycin where sensitivity was 100% in both groups. From the wards and P. O. W. Klebsiella recovered from one specimen was sensitive to gentamycin only aid. from another specimen resistant to ampicillin only.

Strep faecalis. was recovered from 7 specimens and of the 8 antibiotics to which its sensitivity was tested it was 100% resistant to 5 of them, including penicillin - G, lincomycin and methicillin. The highest sensitivity was both to ampicillin and erythromycin (71. 4%). There was only 14. 3% sensitivity to cotrimoxazole. Strep faecalis was recovered from a mixed growth with another microorganism from 3 specimens out of the 4 that had mixed growths.

Proteus. From the 4 specimens from which it was recovered it was 100% sensitive to cotrimoxazole and chloramphenicol only. From one specimen submitted from the Maternity Nursery it was resistant to both kanamycin and gentamycin. This was the only organism in the study that showed resistance to gentamycin where sensitivity to this antibiotic was tested.

Citrobacter. was isolated from 3 neonates and was 100% sensitive to gentamycin, kanamycin, cotrimoxazole and chloramphenicol. There was 100% resistance to ampicillin on the other hand.

Acinetobacter. also isolated from 3 neonates and from one-specimen it was sen stive to cotrimoxazole and gentamycin only. From 2 specimens it was sen stive to the 2 antibiotics above as well as kanamycin. There was 100% resistance to chloramphenicol and ampicillin.

Strep viridans. was obtained from 2 specimens and showed sensitivity to both ampicillin and erythromycin and lincomycin. Both were resistant to cotrimoxazole and penicillin G, and o. ly from one specimen was it sensitive to methicillin.

Alkaligines faecalis. was only grown from the blood of one neonate and was sensitive to gentamyc.in and kanamycin only and resistant to ampicillin, cotrimoxazole and chloramphenicol.

On the whole microorganisms recovered from the group of neonates from the nursery showed increased resistance to most tested antibiotics. This resistance could result from repeated use and exposure of the microorganisms to antibiotics in routine use in in the hospital,

Resistance to antibiotics by gram negative bacilli such E. coli, Klebsiella, Pseudomonas and Proteus species is thought to be mediated by several mechanisms, the most prevalent of which appears to be by plasmids (or R Factors) (3). Plasmids are extrachromosoma! fragments of DNA that can be transferred from one bacterium to another ana can enable the host bacterium to become resistant to a number of agents, including antibiotics. In many instances plasmids mediate the production of enzymes that inactivate antibiotics such as penicillins, cephalosporins, aminoglycosides, or chloramphenicol. In other cases they may produce changes in the cells ability to accumulate a given antimicrobial, or they provide the bacteria cell with the alternate metabolic pathways with which to bypass those steps inhibited by agents such as the sulphonamides or trimethoprim.

CONCLUSIONS

During the period of study positive blood cultures were obtained from 114 neonates from the Kenyatta National Hospital of which 47 (or 41.2%) were from the maternity nursery and 67 (or 58.8%) we e from the paediatric wards and the paediatric observation ward..

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From all the units males outnumbered females giving an overall M:F ratio of 1. 3: 1 which is not statistically significant.

Most of the neonates were 14 days old or less at the time blood was taken and submitted for culture and sensitivity. The younger neonates who were infected were from the nursery 3 of whom had bacterial growth obtained from their blood during the first day of life. Both Staph albus and Staph aureus were commonly isolated from older neonates and in particular those delivered outside the hospital and later admitted when taken ill.

F. coii was the predominant organism recovered from neonates who had been delivered in this hospital and had spent no time outside the hospital.

For all the microorganisms those that were hospital-acquired (i.e. those from maternity nursery) showed increased frequency of resistance to the tested antibiotics. Notable in this respect was E. coli which from the wards and P.O. W. was 100% sensitive to gentamycin, cotrimoxazole, chloramphenicol and kanamycin while from the maternity nursery the sensitivities were 100%, 76, 42. 9% and 35. 7% respectively.

Staphylococcus albus isolated from neonates in this hospital has on average its highest sensitivity to cotrimoxazole followed by lincomycin and has absolute resistance to penicillin - G and ampicillin.

Staphylococcus aureus showed 100% resistance to penicillin - G and ampicillin. Its highest sensitivity was to lincomycin (87. 5%) and cotrimoxazole 79. 2%.

E. coli recovered from all units in this hospital was 100% sensitive to gentamycin only, but hospital -• acquired E. coli was only 37. 5% sensitive to kanamycin.

Klebsiella recovered from the neonates has similar antibiotic sensitivity as E. coli above and the drug of choice would be gentamycin and not kanamycin which would only benefit about 35% of the neonates.

For both Strep faecalis and Strep viridans, ampicillin and erythromycin offer up to 71. 4% coverage and penicillin - G is of no value in this case.

The other microorganisms recovered (i. e. Proteus, Citrobacter, Acinetobacter and Alkaligines faecalis, are uniformly sensitive to kanamycin and gentamycin and although the figures in this study are rathe, few. It appears likely that any of these antibiotics should give adequate coverage.

RECOMMENDATIONS

1. A prospective study be carried out on neonatal septicaemia to determine the actual microorganisms that cause neonatal septicaemia in this hospital and their antibiotic sensitivity pattern. The birth weight and gestational age of the neonate should be included in the study to find out how these factors relate to the microorganisms recovered.

2. Normal term neonates should stay in the hospital nursery as little as possible to avoid coming into contact with microorganisms that have increased resistance to most of the antibiotics in routine use.

3. Where E. coli and Klebsiella sepsis is suspected gentamycin should be administered and not kanamvcin especially when these organisms are suspected to have been acquired in the hospital.

4. Both penicillin - G and ampicillin appear to be of little value in treating neonatal septicaemia in this hospital.

5. Antibiotic sensitivity pattern of all microorganisms should be tested to both gentamycin and kanamvcin as well as semisynthetic penicillins locally available since it is standard practice locally to start any neonate suspected of having septicaemia on a penicillin and an aminoglycoside (i.e. gentamycin or kanamycin).

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ACKNOWLEDGEMENTS

I would like to thank Dr. I. A Wamola, and Dr.]. S. Meme, my Supervisors for their guidance, suggestions and corrections throughout the study, together with members of the Microbiology Department who made the collection of data for this study possible.

I would also like to thank those members of staff of the records Department, Kenyatta National Hospital for their assistance in looking up and sorting out case records for the study.

Last but not least I would like to thank my sister, Miss Loise Mwari, for typing the manuscript for me.