

PUERPERAL AND POSTABORTAL SEPSIS

(A Bacteriological Study)

by

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Infection of the genital tract and endometrium is known for a long time as a frequent hazard for women after delivery and abortion. However, the nature of infection was not clear until the observations made by Gordon Holmes and Semmelweis and subsequently by Coze and Feltz and later by Pasteur, were known (Colebrook, 1956). As a result of their observations, prevention of puerperal sepsis has come into force and its incidence was on the decrease. Nevertheless, it is not completely eliminated and instances of outbreaks of sepsis in postpartum and postabortal patients are known to occur quite frequently.

In recent years, with the universal use of antibiotics, which produced changes in the bacterial flora of man, an alteration in the aetiological agents isolated from puerperal and postabortal infections was recorded by several workers (Ramsay and Vahrman, 1951; Burnett, 1952; Calman and Gibson, 1953; Ramsay *et al.*, 1955; Williams *et al.*, 1960; Eastman

and Hellman, 1961; Murti and Vasumathi, 1963; Leela Naidu and Rao, 1966). Further, the bacterial flora in septic abortions are much more varied than in puerperal sepsis. Many women who have unwanted and unavoidable pregnancies would like to do away with it, and hence adopt measures to induce abortion. For the well known reasons, the chances of infection are greater and the bacterial flora are mixed in such cases (Douglas *et al.*, 1953; Ramsay *et al.*, 1955; Patel *et al.*, 1961; Stevenson and Yang, 1962; Murti and Vasumathi, 1963; Leela Naidu and Rao, 1966).

Since infection of the genital tract is an important cause of puerperal and postabortal sepsis, the present investigation was undertaken to determine the incidence of various species of micro-organisms isolated from the cervix of the patients admitted into the King George Hospital, Visakhapatnam. For better understanding and comparison, bacterial flora of the cervix in the third trimester of pregnancy and in the normal puerperium were also studied as a control group.

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Material and Method

One hundred and fifty patients served as the study group. Among

them 117 were cases of puerperal sepsis and 33 of postabortal infection. One hundred normal patients, without any manifest signs and symptoms of sepsis, were also included in the present study. Among them 50 were patients in the third trimester of pregnancy and the rest were cases of normal puerperium. From each patient two swabs were taken by swabbing the external os of cervix uteri with the help of a sterile speculum to expose the cervix. They were immediately brought to the Department of Microbiology, Andhra Medical College, Visakhapatnam, for processing. One swab was used for the isolation of aerobic organisms by inoculating the following media: (a) Blood agar—one in atmospheric air and the other in CO_2 atmosphere. (b) Nutrient agar. (c) MacConkey's agar. (d) Hartley's broth. The other swab was inoculated into Robertson's cooked meat medium for culture of anaerobic organisms. All the media were incubated at 37°C . for 24 hours. Those which did not show any growth at the end of 24 hours' incubation, were further incubated for a period of 3 days before being reported as negative. Subcultures were made from Robertson's cooked meat me-

dium after 72 hours' incubation, on to a blood agar plate and incubated anaerobically. All the organisms grown aerobically and anaerobically were isolated in pure cultures and the isolates were identified by the study of their morphology, cultural characteristics, biochemical reactions and serological tests according to the standard procedures (Cruickshank, 1965).

Results

One hundred and ninety strains of micro-organisms were isolated from the infected samples examined. A single infecting organism was isolated from 105 (70.0%) specimens, whereas 45 (30.0%) yielded mixed flora. The incidence of single and mixed infections in relation to the nature of sepsis is shown in Table I. The incidence of single infection in puerperal sepsis was 76.1% and mixed infection occurred in 23.9% of cases. In postabortal sepsis, a single infecting organism was isolated from 48.5% of cases and the remaining cases (51.5%) yielded mixed flora.

Bacterial flora in puerperal sepsis: The total number of micro-organisms isolated from 117 patients was 146.

TABLE I
Distribution of patients according to the type of infection
in puerperal and postabortal sepsis

Nature of illness	No. of cases	Type of infection		No. of micro-organisms isolated
		Single	Mixed	
Puerperal sepsis	117	89 (76.1%)	28 (23.9%)	146
Postabortal sepsis	33	16 (48.5%)	17 (51.5%)	44
Total	150	105 (70.0%)	45 (30.0%)	190

Chi Square Test: $\chi^2 = 9.3$; $n = 1$; $P < .01$

A single infecting organism was found in 89 patients, whereas the analysis of bacterial flora in infected samples, containing more than one bacterial species, revealed that a total of 57 strains were isolated from 28 patients with mixed infection. The actual frequency of occurrence of the different species found in single and mixed infections is shown in Table II. The coliform group formed the predominant species in both the types of infection i.e., 48 strains and 27 strains respectively with coagulase negative staphylococci and coagulase positive staphylococci coming next in the order of frequency. The incidence of streptococcus haemolyticus, non-haemolytic streptococci and alkaligenes faecalis was exclusively found in patients with mixed infections.

The overall incidence of the bacterial flora also revealed a similar pattern with coliforms being the most common offending agent (75 strain) followed by coagulase negative staphylococci (30 strains) and coagulase positive staphylococci (21

strains). The other organisms isolated are enlisted in Table II in the descending order of frequency. The coliforms were found to be divided as follows: Escherichia, 66 strains (88.0%), Klebsiella, 7 strains (9.3%) and Citrobacter, 2 strains (2.7%).

Bacterial flora in postabortal sepsis: A total of 44 strains was isolated from 33 cases of septic abortion. Of these, 16 were isolated from patients having single infection and the remaining 28 strains were from 17 cases of mixed infection. The incidence of various organisms isolated is given in Table III. The coliforms were found to be the commonest organisms (21 strains) followed by other organisms as shown in Table III in the descending order. Further identification of coliforms showed that out of 21 strains isolated, 18 (85.7%) belonged to Escherichia and 3 (14.3%) to Klebsiella. The study of frequency of isolation of different bacterial species from specimens containing only one type of organism as well as in mixed infections reveal-

TABLE II
Bacterial flora in puerperal sepsis

Organism	Incidence		
	Single infection	Mixed infection	Total
Coliforms	48	27	75
Coagulase negative staphylococci	16	14	30
Coagulase positive staphylococci	16	5	21
Pseudomonas sp.	2	3	5
Diphtheroids	3	1	4
Streptococcus haemolyticus	0	2	2
Non-haemolytic streptococci	0	2	2
Proteus sp.	1	1	2
Alkaligenes faecalis	0	2	2
Pneumococci	1	0	1
Enterococci	1	0	1
Anaerobic streptococci	1	0	1
Total	89	57	146

TABLE III
Bacterial flora in postabortal sepsis

Organism	Incidence		
	Single infection	Mixed infection	Total
Coliforms	8	13	21
Coagulase negative staphylococci	4	6	10
Coagulase positive staphylococci	3	4	7
Pseudomonas sp.	0	2	2
Streptococcus haemolyticus	1	1	2
Proteus sp.	0	1	1
Non-haemolytic streptococci	0	1	1
Total	16	28	44

ed that coliforms, coagulase negative staphylococci and coagulase positive staphylococci formed the predominant flora in both types of infection in septic abortion, while pseudomonas, proteus and non-haemolytic streptococci were exclusively found in association with mixed infections.

Bacterial flora in the septic and control groups: The overall incidence of the various organisms isolated from cases is summarised in Table IV and a comparison made with the flora from the control group. The organisms commonly found in the septic group were coliforms followed by coagulase negative staphylococci and coagulase positive staphylococci and the bacterial flora did not differ significantly in relation to puerperal and postabortal septic cases, even though the number of patients with septic abortion included in the study was small when compared to the number in puerperal sepsis.

Of the hundred cervical swabs bacteriologically studied from the controls, 17 specimens were sterile and 83 yielded 90 strains of microorganisms. A single organism was isolated from 76 specimens, whereas only 7 yielded mixed flora. The nor-

mal cervical flora in the third trimester of pregnancy and in healthy puerperium, as observed in the present study, is in the order of frequency: Coliforms (29 strains), coagulase negative staphylococci (28 strains) and diphtheroids (18 strains). The other organisms encountered in small numbers were candida species (8 strains), coagulase positive staphylococci (4 strains), non-haemolytic streptococci (2 strains) and one strain of streptococcus haemolyticus.

It can be seen from Table IV that the incidence of coliforms and coagulase positive staphylococci is significantly higher in the septic group than in the control series ($P < .01$). A high percentage of diphtheroids was recorded from the control group indicating their association with the normal cervical secretions. The other potential pathogens like pseudomonas, proteus, alkaligenes, pneumococci, anaerobic streptococci and enterococci were only encountered in septic cases, but figures are too small neither for comparison nor to draw any definite conclusions. Similarly, candida species was present as normal flora in eight of the patients included in the control group.

TABLE IV

Incidence of various organisms isolated from study
and control groups

Organism	Isolated form		Chi ² test with reference to cases
	Study group (150 cases)	Control group (100 cases)	
Coliforms	96	29	X ² = 28.2; P < .01
Coagulase negative staphylococci	40	28	X ² = 0.2; P > .05
Coagulase positive staphylococci	28	4	X ² = 11.6; P < .01
Streptococcus haemolyticus	4	1	X ² = 0.9; P > .05
Diphtheroids	4	18	X ² = 16.6; P < .01
Non-haemolytic streptococci	3	2	X ² = 0; P > .05
Pseudomonas sp.	7	0	....
Proteus sp.	3	0	....
Alk. faecalis	2	0	....
Pneumococci	1	0	....
Anaerobic streptococci	1	0	....
Enterococci	1	0	....
Candida sp.	0	8	....
No growth	....	17	....

Discussion

"The emergence of strains resistant to commonly employed antibiotics, together with an increasing realisation that bacterial infection has not been completely eradicated from the obstetrical wards by modern aseptic techniques and therapeutic agents, has led to a refocussing of interest and attention on the problem of infection in the parturient patient. The pattern of infectious process has been altered by the above factors and requires constant reappraisal and study in the light of changing concepts in management and treatment" (Dean and Russel, 1960).

In the present investigation, occurrence of single infection was higher in puerperal sepsis (76.1%) than in postabortal cases (48.5%), whereas mixed infection was more frequently met with in septic abortions (51.5%) than in puerperal sepsis (23.9%). This difference noted in the incidence of single and mixed infections in

puerperal and postabortal sepsis is found to be significant ($P < .01$). Similar observations were also made by other workers (Ramsay *et al.*, 1955; Murti and Vasumathi, 1963; Ranjit Sen *et al.*, 1965; Leela Naidu and Rao, 1966). This may be due to the fact that in cases of abortion, instrumental interference or otherwise is much more frequent than in cases of full term deliveries. Further, there was no difference in the bacterial flora isolated between puerperal and post-abortal septic cases.

The earliest accepted view was that streptococcus haemolyticus of Lancefield group "A" was the aetiological agent in puerperal and postabortal sepsis (Wilson and Miles, 1964). But recent reports revealed that the pride of place has been taken away by other organisms like *Escherichia coli* and *staphylococcus pyogenes*. As anticipated, in the present series, coliforms were the predominant species in puerperal as well as in post-

bortal infections. Among the coliforms, *Escherichia coli* was the commonest organism encountered.

From the results in Table IV, it is apparent that coliforms have a significant pathogenic role in the aetiology of sepsis, since they were isolated only in 29.0% of the control group as against 64.0% in the septic group ($P < .01$). Our observations are in agreement with the findings of other workers (Burnett, 1952; Ramsay *et al.*, 1955; Murti and Vasumathi, 1963; Leela Naidu and Rao, 1966), who also recorded a high incidence of coliforms in their series. The incidence of different strains of organisms isolated in the present series is compared with the findings of other workers in Table V.

The next common species isolated in the present work is staphylococci, coagulase positive strains being encountered in 18.7% of cases and coagulase negative organisms in

26.7%. Correspondingly, a high incidence of staph. pyogenes was also recorded by Ranjit Sen *et al.*, (1965) and Leela Naidu and Rao, (1966). It is seen in the present study that coagulase negative staphylococci were encountered in more number of cases than coagulase positive staphylococci. But no significant association could be shown between the occurrence of coagulase negative staphylococci and the source of the material ($P > .05$), whereas significant difference was noted between the occurrence of coagulase positive staphylococci in cases and controls ($P < .01$). From the foregoing discussion, it is clear that coagulase positive staphylococci are the second commonest aetiological agent in puerperal and postabortal sepsis. At the same time the role of coagulase negative staphylococci in the causation of genital tract infection cannot be ignored and it can be incriminated when suggestive clini-

TABLE V
Percentage* frequency of various organisms in the genital tract
of puerperal and postabortal sepsis cases as found
by various authors

Organism	Hite et al, 1947	Bur- nett, 1952	Ramsay et al, 1955	Murti & Vasumati, 1963	Ranjit Sen et al, 1965	Leela Naidu & Rao 1966	Present series
Coliforms	11.1	37.1	44.5	53.9	39.2	36.0	64.0
Staphylococcus aureus	..	..	..	5.3	9.8	3.0	2.0
Pseudomonas	..	..	..	3.9	3.9	8.0	4.7
Alkaligenes	..	..	..	1.3	..	..	1.3
Coagulase positive staphylococci	17.8	7.1	9.6	14.5	47.0	35.0	18.9
Coagulase negative staphylococci	..	16.5	..	..	..	5.0	26.7
Streptococcus viridans	..	..	..	..	7.8	1.0	..
Streptococcus haemolyticus	4.4	5.2	5.2	9.2	17.6	2.0	2.7
Non-haemolytic streptococci	40.0	10.1	23.0	..	41.1	..	2.0
Enterococci	..	..	..	1.3	..	5.0	0.7
Anaerobic streptococci	66.7	1.9	15.9	17.1	23.5	3.0	0.7
Pneumococci	..	..	..	1.3	..	..	0.1

*Percentages shown are of the numbers of cases.

cal data are available. The possibility in favour of recognising coagulase negative staphylococci as a potential pathogen is that coagulase positive strains may lose their coagulase activity and become coagulase negative in the presence of antibiotics in use (Agnew *et al.*, 1947) or due to bacterial variations as shown in vitro experiments (Smith *et al.*, 1952) or after prolonged residence in infected tissues (Gorril and McNeil, 1965). This aspect of the problem may be borne in mind while interpreting the role of coagulase negative staphylococci in the pathogenesis of sepsis.

With reference to the incidence of other organisms isolated, fairly wide differences are observed in the frequencies given by various workers (Table V) and it is difficult to draw any definite conclusions. The frequency of isolation of anaerobic streptococci, streptococcus haemolyticus and non-haemolytic streptococci in the present study was conspicuously low in contrast to other workers who encountered them in higher percentages of cases (Hite *et al.*, 1947; Hill, 1950; Burnett, 1952; Ramsay *et al.*, 1955; Ranjit Sen *et al.*, 1965; Rajkumari Popli and Ranjit Sen, 1965). These differences may be due to various factors like nature of cases, duration of illness, the predisposing and precipitating factors in general and in particular due to the universal use and abuse of antibiotics which has successfully eliminated the susceptible organisms from the bacterial flora of the female genital tract, both in health and disease.

The normal flora of the female genital tract as reported by various workers are: Anaerobic streptococci,

staphylococcus albus, staphylococcus aureus, (Eastman and Hellman, 1961; Bender, 1963) and also coliforms, non-haemolytic streptococci, diphtheroids and lactobacillus species (Murthi and Vasumathi, 1963; Leela Naidu and Rao, 1966; Wilson and Miles, 1964). The normal cervical flora as found in the present investigation are in agreement with those of above workers, as most of the organisms mentioned by them were also encountered in the present study. At the same time wide variations in the normal flora can often be observed and it is often liable to sudden changes. These variations may be the result of transient contamination or as a result of inhibitory or even bactericidal effect of cervical secretions which make these organisms non-viable.

As Slotnick *et al* (1963) pointed out, one must take into account the dosage of organisms and indefinitely great number of host-parasite interactions in the pathogenesis of puerperal and postabortal sepsis, since pathogenic bacteria may be regularly harboured in the cervix or vagina during labour and in the puerperium without any adverse effect on the course or outcome of labour, delivery or in the puerperium. It is, therefore evident that the source of infecting microbes in these cases may be of endogenous origin, organisms reaching the uterine cavity from the vagina or cervix through instrumental manipulation i.e., through catheters or while doing speculum examination, or exogenic from the persons attending the patient or through the examining finger or the environmental surroundings. These organisms,

though they are encountered as normal flora in the female genital tract, are capable of assuming a pathogenic role when conditions become suitable for their growth. The retained products of conception in septic abortion and the raw bleeding surface of uterus in parturient women act as suitable culture media for the normal inhabitants or transient contaminants, thereby enabling them to multiply and produce sepsis.

Summary

The bacterial flora of the cervix in 150 patients with puerperal and postabortal sepsis were studied. A total of 146 strains of micro-organisms was isolated from 117 cases of puerperal infection and 44 strains of different species were found in 33 patients with postabortal sepsis.

A control group of 50 patients in the third trimester of pregnancy and 50 in normal puerperium was also investigated for better understanding of the source of infection and to assess the significance of the organisms isolated from cases.

There was no alteration in the bacterial flora in patients suffering from puerperal and postabortal infections. But single infection was observed to be more frequent in puerperal sepsis, while significant association was revealed between the occurrence of mixed infection and septic abortion.

Of the organisms isolated, coliforms and coagulase positive staphylococci were found to be the predominant organisms of aetiological significance and their incidences were 64.0% and 18.7% respectively. Of the coliforms, the commonest species

isolated was *Escherichia coli*. The role of coagulase negative staphylococci which were also found in a large number of cases (26.7%) was discussed with reference to the aetiology of sepsis. Diphtheroids and candida species were shown to be the normal flora of the cervix. The other potential pathogens isolated from a small number of cases were mostly associated with mixed infections.

The bacterial flora as found in the present study are compared with the findings of other workers with a view to show the changing pattern in the causative agents i.e., from streptococci of different types to staphylococcus pyogenes and gram negative bacilli, during the last twenty years. The possible factors responsible for such a change-over are outlined.

The normal cervical flora in the third trimester of pregnancy and in puerperium are reported and the role of these organisms as a source of infecting microbes in the causation of puerperal and postabortal sepsis is discussed.

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