Review Article

Post-Caesarean Section Infection

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ABSTRACT

Post-caesarean infection continues to be a major cause of maternal morbidity and mortality. Understanding the various aspects of this grave complication has improved our approach to its management and prevention. We review the present knowledge about post-caesarean infection regarding: incidence, risk factors, diagnosis, causative organisms, antibiotics and prophylaxis. We conclude that the incidence ranges between 5-85% depending on the population studied; the main risk factors are labour, ruptured membranes and repeated vaginal examinations, the diagnosis is mainly clinical, the infection is polymicrobial, the antibiotics of proven value are gentamycin/clindamycin, ureidopenicillins and third generation cephalosporins. Antibiotics prophylaxis is recommended in all women undergoing elective or non-elective caesarean section

ملخص

الاخماج بعد العملية القيصرية من الأسباب لوفيات وإمراضيات الأمهات. إن التعرف على الجوانب المختلفة لهذه المضاعفة الوخيمة قد ساعد كثيراً في معالجتها والوقاية منها . في هذا المقال نستعرض المعرفة المتوفرة في الوقت الحاضر عن الاخماج بعد العملية القيصرية فيما يخص: معدل الوقوع، عوامل الخطورة، التشخيص، الاحياء الدقيقة المسببة للاخماج ، الضادات الحيوية والاتقاء. وفيما يلي خلاصة هذا الاستعراض: معدل وقوع الاخماج بعد القيصرية يتراوح بين 5-85% اعتماداً على مكان وطبيعة الحالات المدروسة، عوامل الخطورة الرئيسة هي الولادة وتمرق الاغشية وتكرار الكشف المهبلي، يتم التشخيص اعتماداً على الملامح السريرية، الاخماج عديدة الحراثيم، الضادات الحيوية التي تأكد فعاليتها في المعالجة هي جنتامايسن/كلندامايسن – بريدوبنسلين والسفالروسبورين من الجيل الثالث، يُوصي باستعمال الضادات الحيوية للاتقاء من الاخماج في جميع حالات العملية القيصرية الاختيارية والطارئة .

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Introduction:

Public attention is currently focused on the high rates of maternal mortality in the country as a whole and in the hospitals in particular and that fueled the interest of the author to review post-caesarean section infection which is a major cause of maternal deaths. The maternal mortality in the Sudan has been estimated as 640 per 100,000 live births[1]. At Wad Medani hospital the maternal mortality during the years 1995-1996 was estimated as 1121 per 100,000 live births (MD thesis of Dr. Mahdi). In both reports sepsis was identified as one of the main causes of maternal deaths. Much lower rates have been reported from developed countries; 12.2 per 100,000 live births in England and Wales during the years 1994-1996[2]. However, even in the developed countries where the standards of health services are high, sepsis continues to be an important cause of maternal deaths. Out of the 134 maternal deaths in England and Wales 14 were due to sepsis[2]. Caesarean section has been identified as the dominant overall predictor of sepsis. In an attempt to reduce the incidence of post-caesarean section infection, maternity units worldwide have developed strict regimens of caesarean section management. Those regimens were tested several times by well controlled studies. This article will review puerperal infection following caesarean section from several perspectives; incidence, causative microogranisms risk factors, clinical features, diagnosis, drug treatment, complications and antibiotic prophylaxis. It is hoped that the information presented will improve the standards of care in caesarean section and reduce the incidence of infection.

Incidence:

In developing countries where the standard of health care are inadequate, the incidence of puerperal sepsis and its serious complications are alarmingly high; out of the 100 maternal deaths studied at Wad Medani Teaching Hospital 32 deaths were due to sepsis. In developed countries there is a remarkable reduction in the incidence of puerperal sepsis, but it still remains a major obstetric problem. The single most important risk factor in post partum maternal infection is caesarean delivery. Many studies have shown that post-caesarean section infection incidence ranges between 5%-

85%, however, few patients develop major complications of the infection.

In 1993 Alnaes et al from Oslo reported an incidence of post-caesarean section infection as 10% of the 390 patients studied[3]. In that study there was no significant difference between elective or emergency caesarean section. Tran et al studied prospectively 969 women delivered by caesarean section in Vietnam. Infection was diagnosed clinically and by laboratory. They estimated the incidence of infection after caesarean section as 12.4%[4]. A recent study was published in 2000 from Birmingham USA describing infection following caesarean section during the period 1993 to 1996. 322 out of the 1643 caesarean section developed postoperative endometritis giving an incidence of 322/1642 (20%)[5]. Chaim et al from Israel reported a descriptive cross-sectional study of 75,947 deliveries-vaginal and caesarean section-during the period 1989- 1997. They found that the incidence of postpartum endometritis was low among the vaginal and caesarean section deliveries; being 0.17% (120/68,273) and 2.6% (202/7677) respectively[6]. A retrospective cohort study of 256,795 primigravidae, with no chronic medical condition who delivered singleton infants during the period 1987-1996 was reported from Washington State USA. In logistic regression analysis adjusting for maternal age, rehospitalization was found to be more likely in women with caesarean section (RR, 1.85; 95% confidence interval)

or assisted vaginal deliveries (RR, 1.3; 95% confidence interval) than among women with vaginal delivery. They concluded that women with caesarean section and assisted vaginal deliveries were at increased risk of rehospitalization, particularly with infectious morbidity.[7] A high incidence of post caesarean section infection was reported by Hagglund et al. In 321 patients not given prophylactic

antibiotics infection occurred in 56 (25%) of the 228 patients delivered by emergency caesarean section and in 8 (9%) of the 93 patients delivered by elective caesarean section (P = less than .01)[8]. A retrospective study in the department of obstetrics and gynaecology Naples, Italy during the period l. l. 1985 to 31.12.1994 estimated the incidence of infection after caesarean section as 21.2% among 3171 caesarean section done during that period [9]. Gibbs

et al reported a very high incidence of infection after caesarean section. They conducted a prospective clinical and microbiologic study on 413 caesarean section. The incidence of post caesarean section infection among those patients was 160/413 (38.5%)[10] A randomized controlled trial of 265 women delivered by caesarean section showed that 29% of those with intact membranes developed endometritis and 85% of those with ruptured membranes developed endometritis[11]. A high incidence of post caesarean endometritis in women who had ruptured membranes for more than 6 hours was reported by Gilstrap and Cunningham; out of 56 women studied, 53 developed endometritis[12]. Sen P et al studied 236 women delivered by caesarean section. Cultures were taken of the amniotic fluid and endocervix through the internal os during the caesarean section. Of the 236 patients, clinical evidence of endometritis developed in 105[13] Spandorfer et al from University of Pennsylvania USA, reported a retrospective study of post caesarean endometritis of 179 caesarean section. They found an incidence of 20% [14]. Repke JI et al evaluated 50 consecutive patients undergoing caesarean section prospectively. 25 of those 50 patients (50%) had post partum febrile morbidity. [15] At the department of obstetrics and gynaecology Baylor College of Medicine Texas USA, 1500 patients were enrolled in a prospective randomized controlled study on the effects of antibiotics prophylaxis during caesarean section; 231 patients developed postcaesarean

endomeritis[16]. Another study from Texas USA of clinical and microbiologic analysis of the risk factors for puerperal endometritis showed that out of the 607 asymptomatic labouring women 100 (16.5%) developed post-partum endometritis and caesarean section was the most dominant predictor (RR: 12.8)[17]. A prospective study from India estimated the incidence of wound infection after caesarean section as 54/431 (12.52%)[18] . Leigh et al from the department of microbiology, Wycombe General Hospital studied postoperative urinary tract infection and wound infection in women undergoing caesarean section in 1985 and 1987. They estimated the incidence of wound infection as 20% in 1985 and 15.8% in 1987[19]. A prospective study of hospital aquired infection after delivery-vaginal or caesarean section from Lyon France over 3 years estimated an incidence of infection in vaginal deliveries as 1.37% and in caesarean section as 13%. The total deliveries were 9204 and the total caesarean section were 1337[20]. Roberts et al from Texas USA studied prospectively the microbiology of post caesarean section wound morbidity. They found that the incidence of infection was 6.9% of the 939 patients studied[21]. Out of 1104 caesarean section in the department of obstetrics and gynaecology University of Washington Seatle USA 60 developed wound infection[22]. In 1986 Duff reviewed the pathophysiology and management of endometritis following caesarean section. The review showed that endometritis was the most common complication associated with caesarean section and the incidence varies between 5-85%; 2% of the patients developed serious complications[23]

Risk Factors:

Adequate knowledge of the risk factors associated with post-caesarean infection is essential for preventing this major complication and its serious sequalae which are sometimes fatal. Several studies have identified ruptured membranes, prolonged labour and repeated

vaginal examinations as the main risk factors. In places where the standards of health services are inadequate, lack of proper sterilization systems contributes significantly to infection.

Hagglund et al [8] identified the following factors as the main risk factors; duration of the operation of more than one hour, blood loss more than 800 ml, presence of staph aureus in the nares, signs of intra-uterine infection before surgery and failure of progress. The main risk factors among 969 caesarean section from Vietnam[4] were; pre-operative remote infection, chorioamnionitis, severe systemic disease, pre-eclampsia, high body mass index, multiparity and increased surgical blood loss. A descriptive cross-sectional study from Israel [6] showed that pre-term caesarean section, previous caesarean section, anaemia and low apgar score were seen more with endometritis than without. De Gregorio and Hillemanns from Germany reported a study of 385 multiple caesarean section among 2024 caesarean sections during the period 1970-1981. The study showed that multiple caesarean section is associated with a higher risk of complications including infection than first time caesarean section[24]. However, another study from Finland showed that the incidence of infection was not significantly different between women who have had multiple caesarean sections and those with first time caesarean section [25]. Lohe et al published a study of 20 patients who had hysterectomy because of septicaemia after caesarean section in the University of Munich during the period 1971 to 1980. The study showed that the main risk factors were; type of labour, frequent vaginal examinations, attempts at vaginal delivery and internal fetal monitoring [26]. A study from Seatle USA showed that ruptured membranes, labour, prematurity and intrauterine fetal monitoring were important risk factors for bactremia within

15 minutes of placental separation during caesarean section; the incidence was 13/93 (14%) in women who were in labour or ruptured membranes and non among the 26 who were not in labour (P= 0.02)[27.] Ruptured membranes were reported several times (11, 12, 18, 23, 28, 29, 30,31, 32)، as an important risk factor. However, a single prospective study of few patients (50 consecutive caesarean section) showed that the main risk factors were; ante-partum infection, resident staff and extension of caesarean section incision. Unlike most reports, ruptured membranes and frequent vaginal examinations were not found significantly different between the elective and emergency caesarean sectionin[15]. Roex et al published a prospective randomized double blind trial of cefoxitine prophylaxis of 150 patients. The study showed that the main risk factors were; labour, ruptured membranes and the number of vaginal examinations[30]. In a study of 1025 caesarean section from Germany, amniotic fluid was collected transabdominally, and in 990 of them cultures were performed. The bacterial contaminated fluid was correlated to the number of vaginal examinations and ruptured membranes[31]. A prospective study of 431 caesarean section from India showed that the main risk factors were anaemia, repeated vaginal examinations, ruptured membranes and handling by the dai[18]. A study of 311 caesarean sections from Texas USA showed that repeated vaginal examinations and internal fetal monitoring were the main risk factors of post caesarean section infection[33]. Emmons SL et al studied 60 consecutive wound infections among 1104 women undergoing caesarean section. The main risk factors identified in that study were prolonged labour, number of vaginal examinations and internal monitoring[22]. In spite of the sufficient evidence that the duration of labour, ruptured membranes and internal monitoring are the major risk factors of post caesarean section endometritis، Newton et al reported a study which showed that

those factors were not predictors of endometritis[17]. Yonekura ML reviewed the risk factors of post caesarean section endometritis. He identified duration of ruptured membranes and length of labour before caesarean section as the most sensitive, readily available and clinically useful predictors of post caesarean section endometritis. Other risk factors identified in the review were low socio-economic status, anaemia, pre-term labour and number of vaginal examinations[29]. A review of pathophysiology and management of post caesarean section endometritis identified young age، low socio-economic status, duration of labour and ruptured membranes as the main risk factors of post caesarean section infection[31]. Faro et al reviewed the use of ticarcillis/clavulanate for treatment of postpartum endometritis. He showed that duration of labour with ruptured membranes of greater than 6 hours was the main risk factor.[32]

Prophylaxis:

The prophylaxis of infection following caesarean section starts at the ante-natal clinic where at risk pregnancies are identified and managed accordingly. Proper ante-natal care reduces the number of emergency caesarean sections which are associated with a higher incidence of infection. During labour prophylaxis includes; optimum hygienic set up، active management of labour to avoid prolonged and obstructed labour؛ minimum number of vaginal examinations. The caesarean section should be performed in a well equipped hygienic theatre with facilities for standard sterilization. The effectiveness of the whole sterilization system should be monitored continuously according to standard guidelines set by the department of microbiology. The steps of sterilization should be followed strictly and any defect in the machine should be instantly reported. The caesarean section should be performed by a skilled operator who can finish the operation within one hour and with minimum blood loss.

However, even under optimum conditions patients may develop infection after caesarean section which Might be serious or even fatal. The placental site is a favourable medium for organisms to grow and commensales which could be pathogenic under certain conditions, the poor general condition of the patient postoperatively favours infection. There is enough evidence in the literature that antimicrobial prophylaxis in caesarean section reduces the post operative infection and it has become the standard care in many countries. Many different antibiotics have been used successfully, however the most frequently used class of antibiotics is the cephalosporins group. Considering the polymicrobial nature of the infection more than one antibiotic regimens have been advocated but recently single dose regimens have proven to be equally effective. The single best agent has not been determined yet.

A less expensive narrow spectrum cephalosporin is as effective as more expensive broad spectrum cephalosporins as prophylaxis in patients undergoing non-elective caesarean section. A randomized controlled study from USA compared cefazolin (n= 63), cefoxitive (n =66) and cefotaxime (n= 60) used as a single dose. There was no significant difference in the incidence of immediate or delayed post operative infection[34].

Stiver HG et al studied 354 patients who underwent non-elective caesarean section. It was a randomized double blind controlled study which compared cefazolin (119 patients), cefoxitine (124 patients) and a placebo (111 patients). In the placebo group 24.3 developed post operative genital tract infection. In the cefoxitine group 5.6% and in the cetazolin group 6.7% developed infection (P = less than 0.001). It is concluded that prophylactic antibiotics reduce the incidence of infection following caesarean section[35]. A retrospective study from Napoli Italy showed that the prophylactic use of cefazolin or

ampicillin soon after caesarean section was able to reduce significantly the incidence of postoperative infection morbidity. 3171 women delivered by caesarean section were studied. 2748 patientshad prophylactic antibiotics and the rate of infection among them was 23.4% in the primary caesarean section and 16.6% in the iterative caesarean section. 423 of the 3171 caesarean section were not given prophylactic antibiotics and the incidence of infection was really high, being 33.8% in the primary and 27.4% in the iterative caesarean section[9]. Periti et al from Florence, Italy, published the results of a multicentre randomized study of 460 patients who had a hysterectomy or caesarean section. 229 patients were given cefotetan (single 2g intravenously before surgery) and 231 were given cefazolin (2 doses 2 g intravenously before surgery). Among patients of caesarean section 9/78 (11 .5%) and 7/64 (10.9) were infected following cefotetan and cefazolin respectively and the difference between the two groups was not signif1cant[36]. A randomized controlled study of 441 caesarean section (211 emergency and 230 elective) from Jeddah Saudi Arabia tested a regimen of a single dose 1 g cefazolin intravenously at the time of clamping the cord against a placebo. In the placebo group 34 (%30.6)of the emergency caesarean section developed post operative infection compared to 11% in the cefazolin group (P =0.001). There was no statistically significant difference between the two groups in the elective caesarean section[37]. A prospective randomized multicentre study in the department of pre-clinical and clinical pharmacology - University of Florence, showed that a single dose of cefotaxime (2g I.V. before surgery) or 2 doses of cefazolin (2 g I.V. before surgery and after 8 hours) used as prophylaxis in hysterectomy, myomectomy and caesarean section are of similar prophylactic activity. 552 patients were studied (276 cefazolin and 276 cefotaxime). 9.1% in the cefazolin group and 7.2% in the cefotaxime group developed wound

infection; the difference was not significant[38]. Zhanel Winnipeg reported an audit of the medical records of women who had received antimicrobial therapy for hysterectomies and emergency caesarean sections. The audit showed that cefazolin and cefoxitine were found to be equally efficacious in prophylaxis of post operative infections following obstetric and gynaecologic operations[39]. A prospective randomized double blind controlled trial of 150 caesarean section at a university hospital in USA showed that the prophylactic use of cefoxitine (3 doses 12 hourly, first dose immediately after clampining the cord) was effective in reducing post operative infection after caesarean section.[30]

The aetiology of post operative infection following obsteric gynaecologic surgery including caesarean section is often mixed aerobic and anaerobic flora with a predominance of gram negative organisms and hence a third generation cephalosporin must be considered. In the field of surgical prophylaxis more experience has accumulated with cefotaxime used as a convenient single dose; its broad spectrum activity provides coverage against most potential pathogens[40]. Another study showed that a single dose of third generation cephalosporin is both effective and convenient. A single dose of ceftriaxone was compared with three doses of cefoxitine I g I.V. in a randomized controlled trial of 1052 patients undergoing caesarean section in the university department of obstetrics gynaecology Zurich. Post operative infection rate was 6.5% with ceftriaxone and 6.4% with cefoxitine[41]. Giulianc et al from Italy reviewed 1021 caesarean section (597 elective and 424 emergency) and 814 gynaecological operations between 1997-1998. 83.6% of the obstetric patients and 75.1% of the gynae patients received 1-2 g of first or second generation cephalosporin I.V. as a single dose at induction of anaesthesia and sometimes a second dose is used. 1.5% of the obstetric and %2.8of

the gynae patients developed wound infection[42]. Faros reviewed the prevention of infections after obstetrical and Gynaecological surgery and commented that the benefits of prophylaxis after caesarean section are clear-cut[43]. Berger et al reviewed antimicrobial prophylaxis in obstetrical and gynaecological surgery. The review included 33 human studies (82% prospective, 70% randomized and 39% double blind) were analysed. 27 of the 28 papers published after 1966 advocated prophylaxis[44]. A review of antimicrobial prophylaxis in Obstetrics and gynaecology from Oslo recommended prophylaxis[45]. Gentry published a review which showed that a single dose of cefotaxime 1-2 g given 30 minutes prior to surgery (GIT - Obst-Gyn) is more effective than multiple doses of cefazolin - P = less than 0.01[46]

A Cochrane review - antibiotic prophylaxis for caesarean section was conducted by Smail and Hofmeyr . They searched the Cochrane Pregnancy and Child birth group trials register. Randomized trials comparing antibiotic prophylaxis or no treatment for both elective and non elective caesarean section were selected. 66 trials were included. It was found that the use of prophylactic antibiotics in women undergoing caesarean section substantially reduces the incidence of fever; endometritis, wound infection, urinary infection and serious infections. The relative risk for elective caesarean section was 0.24 (95% confidence interval 0.11 to 0.48) and for non-elective caesarean section was 0.30 (95% confidence interval 0.26 - 0.33). Despite the large number of trials, different populations and different antibiotics regimens there was no statistically significant heterogeneity. The reviewers concluded that the reduction of endometritis by two thirds to three quarters justifies the policy of antibiotic prophylaxis in women undergoing elective or non-elective caesarean section[47]

Antibiotics Treatment:

Endometritis is the most common complication associated with caesarean section. Antibiotics are the mainstay in its management and should be started without obtaining endometrial culture. The principal microorganisms are group B streptococci, aerobic gram negative bacilli, aerobic gram positive cocci and anaerobic gram negative bacilli. Antibiotics of proven value include broad specrum cephalosporins، ureidopenicillins and the combination of clindamycin and gentamycin[23] The treatment of endometritis should include broad spectrum anaerobic coverage as well as gram negative and gram positive aerobes[48]. The standard combination of clindamycin and gentamycin has been reported several times as an effective antibiotic regimen in the treatment of post caesarean section endometritis[13,23.32,33,49,50,51,52,53,54.] The clindamycingentamycimegimen has been compared with other antibiotics in many studies. In a prospective randomized controlled study of 47 patients، Apuzzio et al compared ticarcillin / clavulanic acid (3 g ticarcillin + 100 mg clavulanic acid intravenous every 4 hours) with clindamycin./gentamycin (600 mg clindamycin I.V. every 6 hours + 3.5 mg/kg per day of gentamycin inramuscular) regimen. The treatment was successful in all patients of clindamycin / gentamycin group and failed in 9% of the ticarcillin/ clavulanic acid group, but the difference was not significant[50]. Also Faro reported a review which showed that the most frequently utilized antibiotic regimen employed for the treatment of post caesarean section endometritis is the combination of clindamycin and gentamycin and that ticarcillin calvunate has a similar effect[32]. Faro et al studied 152 women who received cefazolin prophylaxis and subsequently developed postpartum endometritis. The patients were assigned randomly either to ticarcillin / clavulanic acid (75 patients) or

gentamycin /clindamycin (17 patients). The cure rate in both groups was similar. The authors recommended ticarcillin clavulanic acid because of its increased activity against beta lactamase producing activity and of it being less toxic)[53]. Sen et al studied 236 patients for the development of endometritis following caesarean section. 105 of the 236 patients developed endometritis and they were treated with a combination of either clindamycin and gentamycin or cefazolin and gentamycin. All of the 54 patients receiving clindamycin/gentamycin improved but 8 of the 51 patients in the cefazolin group failed to respond, but subsequently improved after the administration of clindamycin[13]. The gentamycin/clindamycin regimen was found to be more efficacious in the treatment of severe infection after caesarean section than ceftizoxime or cefoxitin alone. The results of this study suggested caution in substituting the standard clindamycin/gentamycin regimen with a single drug of third generation cephalosporin[51]. Stovall et al studied 77 patients in a prospective randomized controlled trial to compare two regimens for the treatment of post-caesarean section endometritis. 30 (81%) of 37 patients receiving ampicillin/sulbactam and 33 (83%) of 40 receiving gentamycin/clindamycin responded to treatment. There were 14 (18%) treatment failures, 7 in each group. Five (35%) of 14 clinical failures were due to septic pelvic thrombophlebitis, 2 (14%) of the 14 failures were complications of intra-abdominal abcesses and the remaining 7 responded after change of regimen. The authors concluded that ampicillin/sulbactam and gentamycin/clindamycin regimens are similarly effective[54], Brumfield et al published an evaluation of a standardized prospective protocol of antibiotic treatment of puerperal infection following caesarean section. Between 1993-1996, 322 of 1643 (20%) women were diagnosed with post caesarean endometritis. Antibiotic therapy included gentamycin/clindamycin and ampicillin (or vancomycin) as a triple

antimicrobial in 148women. 174 (54%) were cured with clindamycin + gentamycin and 129 additionally received ampicillin or vancomycin (40%) were cured. 9 of the 322 (6%) women had fever despite triple antibiotics. The protocol cured 303 of 322(94%).[5] In a randomized controlled trial Filler et al compared three different antibiotic regimens (trospectomycin+ azteonam, clindamycin + azteonam and triple antibiotics ampicillin+ clindamycin + gentamycin) in the treatment of post-caesarean endometritis. The study showed that the three regimens were all effective[52]. Martens et al reported a randomized controlled study which showed that Ofloxcin and Ciprofroxacin have beter activity against most of the gram negative isolates but their activity against anaerobes is inferior to clindamycin and metronidazole[16]. Hillier Satal studied 27 women who developed post-caesarean endométritis after cephalosporin prophylaxis. The women were assigned in a double blind randomized fashion to receive either ticarcillin/clavulanice 3.2 g, or cefoxitine 2 g administered every six hours. The overall clinical success rate with these single agent treatments was not different for the two groups (77% - 79%, P = I .0) [55]. The types of antibiotics used in the treatment of post caesarean section infection have changed over the years. In 1978 Gibbs published a prospective clinical trial on 413 caesarean section, 160 of them developed infection. In those patients penicillin and kanamycin were used initially and those who failed were treated with chloramphenicol or clindamycin. Penicillin and kanamycin were successful in 125/160 (78%)[10]. A randomized controlled study published in 1978 showed that intravenous penicillin and tetracycline were found to be as effective as the combination of intramuscular penicillin and tobramycin[11].

Microorganisms:

The aetiology of post-caesarean infection is often polymicrobial. The principal microorganisms are group B streptococci, aerobic gram negative bacilli, anaerobic gram positive cocci and anaerobic gram negative bacilli[23]. A variety of microorganisms have been identified in many studies. Knowledge about the microorganisms is essential both in the prevention and treatment of infection.

Boggess et al studied 93 women undergoing caesarean section after a minimum of 4 hours labour and 26 women not in labour undergoing caesarean section. They found that the microbiology of bacteremia within 15 minutes of placental separation during caesarean section included: group B stresptococcus, Gardnerrella vaginalis, streptococcus pneumonlae, peptostreptococcus, mixed flora of Prevotella bivia and viridans streptococcus[27]. Gilstrap and Cunningham studied 56 women who underwent caesarean section after ruptured membranes for more than 6 hours. Amniotic fluid was obtained transabdominally at the time of caesarean section. In all specimens bacterial growth was demonstrated and 53% of them developed endömetritis. More than 90% of the specimens had had polymicrobial anaerobic/aerobic growth (63%) or anaerobes only (30%). Anaerobic and aerobic streptococci accounted for 72% and Bacteroides and E. coli were next. These data indicate that ascending colonization of flora from the lower genital tract usually result in polymicrobial pelvic infection with a predominance of anerobic organisms[12]. Dizaerega et al presented blood culture results obtained from 200 patients with post-caesarean endometrities. The results showed that 53% of the 60 organisms isolated form 48 patients were anaerobic[49] Gerstner et al studies 51 women with clinical signs of endometritis following vaginal (27 patients) or caesarean section (24 patients). Transcervical swaps were cultured aerobically and

anaerobically. The aerobes most frequently recovered were staphylococcus epidermidis, E .coli, Enterococci and streptococci. The prevalent anaerobes were the gram positive anaerobic cocci, peptostreptococcus and Peptococcus and Bacteroides species[56]. In a prospective randomized controlled study Karhunen et al tested tinidazole efficiency as antimicrobial prophylaxis in caesarean section. In that study blood cultures were done for 152 patients with endometritis. 27 positive bacterial cultures yielded a pure anaerobic growth in 16/27 (59%) of the cases[57]. Gibbs reviewed the role of aerobic gram negative bacilli in endometritis after caesarean section. He found that they account for 25% of blood isolates and E. coli was the most common followed by Klebsiella pneumonia, proteus miribalis, En-terobacteria and Pseudomonus[58]. Faro reported a review which showed that post-caesarean section endometritis is usually polymicrobial, aerobic facultative, obligate anaerobic gram negative bacteria and gram positive bacteria[32]. Marlens et al studied 1500 caesarean section; 231 of them developed endometritis. The organisms isolated from the endometrial swaps cultures were; Enterococcus feacalis, staphylococcus aureus، E. coli, Bacteroides, Gardnerrella vaginalis, streptococcus epidermis، proteus miribalis and lactobacillus[16]. Hjillier et al reported a randomized controlled trial about the aetiology and treatment of post-caesarean section endometritis after cephalosporins prophylaxis. In that study a total of 149 micro-organisms were identified in cultures obtained from 27 patients (84 facultative and 65 obligate anaerobes). Bacteroides and peptostreptococcus were the most frequent isolates[35]. Genital myco-plasma have been shown to be important bacteria in post-caesarean section wound infection. In a prospective study of 939 wound infections after caesarean section, the following organisms were isolated; ureaplasma urealyticum (62%), coagulase negative

staphylococci and Enterococcus faecalis (28%)[21]. Chia at al from Singapore published a survey of postoperative wound infection following 6639 abst and Gyn major operations. Staphylococcus aureus was the most common organism isolated[59]. A number of studies evaluated the relationship between the organisms found in the amniotic fluid during labour and post-caesarean endometritis. D Angelo and Sokol reported a study which showed that there is a strong relationship if streptococci, nacteroides، gram negative bacilli or staphylococcus aureus is isolated[60]. Berle et al from Germany published a study of 1025 caesarean section which showed that there is a significant influence of positive amniotic culture collected transabdominally at the time of caesarean section on the wound healing and febrile morbidity. Organisms isolated form 990 cultures were; staph epidermis (36.38%), streptococcus. B (12.23%), staphylococcus D(10.3%) ،(E.col (8.4%), staph aureus (7.8%), Peptococci (3.26%), staphylococcus salivarius (2.99%) and Bacteroides (2.4%)[31]. Pass studied puerperal and perinatal infections with group B streptococci. He showed that it was a cause of postpartum infection following vaginal or caesarean section in 21 patients[61]. A serious case of post-caesarean endometritis was reported by Patai et a1[62]. Bitti et al reported the first case in the literature of post partum death in which a toxigenic clostridium sordellii was isolated from the patients blood antemortum during the fatal toxic shock[63].

Diagnosis:

The diagnosis of post-caesarean infection is usually based on clinical features and its treatment without obtaining cultures is an accepted gynaecological practice. The following criteria are used for the diagnosis: persistent fever of 100.4 ^{O}F or more beyond 24 hours after caesarean section, uterine tenderness, tachycardia, foul vaginal discharge and leukocytosis. Cultures are routinely performed to

identify the causative organisms and its antibiotic sensitivity. Specimens for culture are taken from endocervix, wounds, amniotic fluid and blood, however the yield from them is very small[49]. Although blood culture is currently used for diagnosis the yield is not always satisfactory. Spandorfer published a retrospective review of 179 patients diagnosed with post-caesarean endometritis. 168 patients had blood cultures and only II (6.5%) were positive and the most important association was with a temperature of 38.8^{o}C or more. The authors concluded that the traditional practice of obtaining blood for culture at a temperature of 38 ^{o}C or more is not justified but elevating the threshold to 38.8 ^{o}C is equally effective[14]. A high yield is obtained when transcervical endometrial swaps are used. Gerstner presented the results of culture of transcervical endometrial swaps from 51 patients (27 vaginal and 24 caesarean section). In vaginal deliveries aerobic bacteria were isolated in 85.2%, anaerobic in 62.9% and mixed in 48.1%. In the caesarean section group anaerobic in 83.3%، aerobic in 75.1% and mixed in 58.4%[56]. The yield was also very high when endometrial swaps were obtained by triple lumen catheter from the endocervix. Out of 27 specimens, only one was found to be sterile[55]

Complications:

The major complications of post-caesarean section infection are peri-tonitis and septicaemia. They are .associated with a very high mortality. Patients are frequently diagnosed clinically, however laboratory findings have always been of great benefit in the management. Clinical features of septicaemia includes; pyrexia, severe abdominal pain and tenderness, neurological manifestations, leukocytosis, shock and renal insufficiency. Peritonitis include, in addition to the features of septicaemia, abdominal distension, absolute constipation and absent bowel sounds. Patients with these grave complications are best managed in intensive care units. They are treated with high doses of broad spectrum antibiotic and rigid monitoring of body fluids, renal functions and serum electrolytes. Abscesses are drained. Some patients will need dialysis. Many patients continue to deteriorate inspite of this intensive therapy and in an attempt to save them hysterectomy is sometimes performed to remove the focus of infection. However few studies reported the use of hysterectomy when medical treatment fails. The number of patients reported is limited[26'64'65, 66,67]

Conclusion:

The single most important risk factor for postpartum maternal infection is caesarean delivery. In spite of the tremendous advances in the health services in developed countries post-caesarean infection continues to be an important cause of maternal mortality. In developing countries it is the leading cause of maternal deaths. The main risk factors are: labour, ruptured membranes and repeated vaginal examinations. The diagnosis is essentially clinical coupled with cultures which usually have a low yield. The infection is frequently polymicrobial. Antibiotics of proven value in the treatment are: clindamycin/ gentamycin، ureidopenicillins and third generation cephalosporins. There is enough evidence to recommend prophylactic antibiotics to women undergoing elective or non-elective caesarean section.

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