EDITORIAL

Antibiotic Prophylaxis in Surgery

V K E Lim, FRCPath, Department of Medical Microbiology and Immunology, Faculty of Medicine, Universiti Kebangsaan Malaysia, PO Box 12418, Kuala Lumpur

One of the more dramatic effects of antimicrobial chemotherapy has been its influence on the practice of modern surgery[1]. The use of perioperative antibiotic prophylaxis has been shown to prevent post-surgical wound and other infections. When employed rationally, significant reductions in morbidity and mortality as well as savings in resources can be clearly demonstrated. However, when used excessively in conditions where its benefit has not been established, negative effects like unjustifiably high costs of medical care and the emergence of bacterial resistance can occur.

The benefits of antimicrobial prophylaxis were first demonstrated in animal experiments. Miles in the mid-1950s showed that streptomycin protected against pseudomonal dermal infections in animals if the antibiotic was given within 3 hours of the bacterial inculation[2]. Miles referred to this crucial interval as the *decisive period.* Burke, several years later, showed quite conclusively that administration of penicillin in guinea-pigs inoculated intradermally with *Staphylococcus aureus* prevented infection if the penicillin was given shortly before or after the inoculation of the bacteria[3]. If the administration of penicillin was delayed more than 3-4 hours after bacterial inoculation, the prophylactic effect was lost. This decisive period probably represents the time required by the bacteria to establish an infection. Once an infection is established prophylactic antibiotics become useless. The significance of this important principle in the clinical setting was demonstrated by Classen *et al* some thirty years later[4]. Classen prospectively monitored 2847 patients undergoing elective clean-contaminated and contaminated procedures. Of the 1708 patients who received antibiotics during the two hours prior to incision, the infection rate was 0.6%. This contrasted with an infection rate of 1.4% in 282 patients who received antibiotics in the 3 hours after incision and 3.3% infection rate in 488 patients who only received antibiotics 3 hours or more after incision. Statistical analysis of these results confirmed that administration of antibiotics in the 2 hours before surgery was associated with the lowest risk of infection. The timing of antibiotic administration is therefore crucial and a single pre-operative dose given at time of induction of anaesthesia is sufficient in most cases. Where operations are prolonged a second intra-operative dose may be necessary.

While the value of antibiotic prophylaxis in clean-contaminated and contaminated operations is quite clear, the use of such prophylaxis in clean surgery remains controversial. Platt *et al* assessed the efficacy of antibiotic prophylaxis in 1218 patients undergoing herniorrhaphy and breast surgery[5]. Patients who received prophylaxis had 48% fewer *probable* or *definite* infections compared to those who did not. However, if only *definite* infections were taken into account the difference in infection rates was not statistically significant[6]. Proponents of antibiotic prophylaxis for clean surgery point out that the true rates of septic complications following such operations may have been grossly underestimated[7]. This is because many infectious complications may develop only after patients are discharged and may not have been recorded. This was demonstrated in a study conducted in Southampton involving 560 herniorrhaphy patients[8]. In this study each patient was closely monitored by trained surgical nurses in the community after discharge from hospital. Using such aggressive surveillance methods an infection rate of 13.2% was recorded. This is much higher than the oft quoted rate of below 5% for herniorrhaphy.

In this issue of the journal, Huam *et al* reports on their experience with antibiotic prophylaxis in women undergoing elective Caesarean section in a Malaysian teaching hospital[9]. While the value of prophylactic antibiotics in emergency Caesarean operations is well

established, its use in elective, low-risk operations is less clear. There has been conflicting reports on this matter. Nice *et al* studied 4076 women undergoing delivery in five West Yorkshire maternity units[10]. They found a Caesarean rate of 15.4%. The overall infection rate following Caesarean section was 7.2% (ranging from 2.5 - 17.2%). The infection rate when antibiotic prophylaxis was used was 6.2% compared to 7.7% without antibiotics; the difference being not statistically significant. They concluded that antibiotic prophylaxis be limited to selected women at high risk. In another study from Australia involving 428 patients undergoing Caesarean section, a wound infection rate of 25% was recorded[11]. Interestingly over a third of these infections occurred after discharge. Antibiotic prophylaxis was found to be the most significant protective factor in the reduction of post-caesarean wound infection. A single prophylactic dose of ampicillin has been shown to reduce the post-caesarean infection rate from 38.2% to 15.2% in rural Uganda[12]. In Huam's study[9] a single prophylactic dose of amoxycillin-clavulanic acid reduced post-operative infectious morbidity from 38% to 19%, a result not too dissimilar to the Ugandan study.

These studies suggest that the value of antibiotic prophylaxis in Caesarean section may depend to some extent on the local circumstances prevailing in the institution practising it. The results obtained from one centre cannot be applied universally and each institution will have to formulate a policy best suited to its needs. However, the cost-benefit of giving routine antibiotic prophylaxis should be carefully analysed and surgeons should always be made aware that antibiotics cannot substitute for poor surgical technique.

References

1. McDermott W, Rogers DE. Social ramifications of control of microbial disease. John Hopkins Med J 1982;151 : 301-12.
2. Miles AA. Non-specific defense reactions in bacterial infections. Ann N Y Acad Sci 1956;66 : 356-69.
3. Burke JF. The effective period of preventive antibiotic action in experimental incisions and dermal lesions. Surgery 1961;50 : 161-8.
4. Classen DC, Evans RS, Pestotnik SL, Ham SD, Menlove RL, Burke JP. The timing of prophylactic administration of antibiotics and the risk of surgical wound infections. New Engl J Med 1992;326 : 281-6.
5. Platt R, Zaleznik DF, Hopkins CC, Dellinger EP, Karchmer AW, Bryan CS *et al.* Perioperative antibiotic prophylaxis for herniorrhaphy and breast surgery. New Engl J Med 1990;322 : 153-60.
6. Hopkins CC. Antibiotic prophylaxis in clean surgery : peripheral vascular surgery, noncardiovascular thoracic surgery, herniorrhaphy and mastectomy. Rev Infect Dis 1991;13(Suppl 10) : S869-73.
7. Ranaboldo CJ, Karran SE, Bailey IS, Karran SJ. Antimicrobial prophylaxis in 'clean' surgery : hernia repair. J Antimicrob Chemother 1993;31(Suppl B) : 35-41.
8. Bailey IS, Karran SE, Toyn K, Brough P, Ranaboldo C, Karran SJ. Community surveillance of complications after hernia surgery. BMJ 1992;304 : 469-71.
9. Huam SH, Lim JMH, Raman S. Single dose antibiotic prophylaxis in women undergoing elective Caesarean section. Med J Malaysia 1997;52 : 3-7.
10. Nice C, Feeney A, Godwin P, Mohanraj M, Edwards A, Baldwin A *et al.* A prospective audit of wound infection rates after Caesarean section in five West Yorkshire hospitals. J Hosp Infect 1996;33 : 55-61.
11. Beattie PG, Rings TR, Hunter MF, Lake Y. Risk factors for wound infection following caesarean section. Aust N Z J Obstet Gynaecol 1994;34 : 398-402.
12. Reggiori A, Ravera M, Cocozza E, Andreata M, Mukasa F. Randomised study of antibiotic prophylaxis for general and gynaecological surgery from a single centre in rural Africa. Br J Surg 1996;83 : 356-9.