Leading articles


The prevention of wound infection after coronary artery bypass surgery

Sternal wound infection, one of the many possible complications of open heart surgery, has a sinister reputation and may progress to mediastinitis, osteomyelitis and bacteremia; it has a high mortality (7-45%) and the survivors often require extensive wound debridement (Sarr, Gott & Townsend, 1984). Risk factors for sternal sepsis have recently been reviewed by Sarr *et al.* (1984).

Although both coronary artery bypass graft (CABG) and valve replacement operations are conventionally "clean" and require cardiopulmonary bypass (CPB), in CABG no intravascular prosthesis is involved but instead saphenous veins are harvested from the upper thigh. Two recent reports emphasized the differences between the two operations and related them to post-operative infection (Wells, Newsom & Rowlands, 1983; Farrington *et al.*, 1985a). Both found sternal wound sepsis to be common after CABG (about 8%) and to be caused by *Staphylococcus aureus* or endogenous, antibiotic-sensitive coliforms; coliforms were also often isolated from leg incision infections. Sternal infection after valve replacement was less common (about 2%) and predominantly staphylococcal. Available evidence suggests peri-operative implantation of pathogens; Kluge *et al.* (1974) found extensive contamination of chest wounds in theatre with skin commensals, but coliforms and *S. aureus* were occasionally also isolated. During CPB the patient may be exposed to wound contaminants via the blood stream since blood (with theatre air and other contents of the wound) is aspirated from around the heart and returned to the circulation. Wells *et al.* (1983) suggested that bowel flora was
transferred from the skin of the upper leg to the chest with the saphenous veins. In the St Thomas's study most severe infections were characterized by the sudden discharge of pus through a superficially healed sternal wound soon after surgery, and oozing sternotomy wounds seldom progressed to deeper sepsis (Farrington et al., 1985a). Post-operative seeding of the sternal wound has rarely been proved (Weinstein et al., 1976; Stiver et al., 1979). All seven strains of *S. aureus* at Papworth were of the same phage type, suggesting a common source (Wells et al., 1983) whereas, in the St Thomas's study, all strains were distinguishable but three of the five from CABG sternal infections were endogenously derived (Farrington et al., 1985a).

Prophylactic antibiotics were introduced in the 1960s in response to the high reported rate of early prosthetic valve endocarditis (Herr et al., 1965) and became routine for all open heart operations without critical evaluation (Hirchmann & Inui, 1980). Numerous regimens have been proposed: cephalosporins are extensively used in the U.S.A. (Beam, 1985) and flucloxacillin, often with gentamicin, is the most popular choice in the U.K. (Wilson et al., 1986).

Only four placebo-controlled trials of prophylaxis in CABG have been reported and all may be criticized on technical and statistical grounds. In a study of 904 patients, Sutherland et al. (1977) found a low rate (1.1%) of sternal infection with systemic penicillin plus methicillin and a similar rate (1.8%) without prophylaxis. Details of the regimen were not given and several surgeons operated, but special care was paid to skin disinfection and wound washouts with antibiotics in both groups. Austin et al. (1980) ended their trial after 15 patients had been entered because four sternal infections with distinct *S. aureus* strains occurred in those given placebo rather than high dose peri-operative cephalothin. An antibiotic spray was used before closure in all cases. Fong, Baker & McKee (1979) recorded ten sternal infections in 47 patients treated with placebo and none in 58 given peri-operative methicillin, but their definition of infection required a positive culture. A study by Penketh et al. (1985) was also abandoned because of 12 wound infections in the 22 patients receiving placebo instead of cephradine, but sternal and leg infections were neither defined nor distinguished in the analysis, antisepsis was altered during the trial and theatre ventilation was inadequate.

The need for systemic prophylaxis in CABG cannot be established without a prospective, randomized and double-blind study (Hirchmann & Inui, 1980) which should be prolonged, large (Kaiser, 1984; Platt, 1984) and preferably multi-centre. Sternal infection should be well defined (Polk, 1978) and antisepsis (Kelly & Williams, 1985) and theatre ventilation should also be considered. Sternal sepsis alone should be the measure of efficacy.

Only limited conclusions can be drawn from the many comparative studies of prophylactic agents in open heart surgery which have recently been reviewed by Beam (1985). *S. aureus* is the commonest isolate when no prophylaxis is given (Sutherland et al., 1979) and no well-designed trial has shown broad spectrum agents to be superior to high dose peri-operative flucloxacillin for CABG. Flucloxacillin has little effect on normal flora (Freeman, 1980), but Weinstein (1985, 1986) has related enterobacter colonization and infection of cardiothoracic patients to widespread cephalosporin usage, and the addition of amoxycillin to flucloxacillin may encourage the emergence of *Klebsiella* spp. and other amoxycillin-resistant coiforms (Farrington et al., 1985a).

If prophylaxis is to be used in CABG, adequate serum and wound concentrations should be maintained throughout these long operations (Farrington, Fenn & Phillips, 1985b). Many recommended regimens for prophylaxis during CPB are based upon concentrations measured in cardiac muscle, which are probably irrelevant when an intracardiac prosthesis is not inserted. A large intravenous dose should be given at induction of anaesthesia with, for agents with a half life of under about two hours, another dose later in the operation (Beam, 1985); the most suitable time for this is at the end of CPB (Farrington et al., 1985b). Nevertheless, high serum and tissue concentrations of appropriate antibiotics have not abolished infection with sensitive organisms (Karney et al., 1983). Two groups have assessed the duration of prophylaxis after CABG, showing no advantage of extended administration over either peri-operative (Austin et al., 1980) or 48 h usage (Hillis et al., 1983). Prolonged prophylaxis may result in superinfection with resistant organisms (Conte et al., 1972; Goldman et al., 1977) thus antibiotics should be restricted to the immediate operative period even for 'high risk' patients.

The emphasis should be on good surgical technique and intensive pre-operative use of antisepsics rather than broad spectrum antibiotics. Repeated disinfection of the vein donor site the day before operation may be valuable (Wells et al., 1983); the perineal flora is little affected by single applications of chlorhexidine or povidone iodine (Gilmore et al., 1984). Meticulous skin preparation is required in
theatre, and perhaps also in the anaesthetic room, with an alcoholic disinfectant. Chemical depilation reduces wound infection rates and electrocautery, widely used in cardiac surgery, increases them (Cruse & Foord, 1980). Careful operating technique will greatly reduce infection of the leg wounds (DeLaria et al., 1981; Karney et al., 1983) which should not extend to the upper thigh, and the surgeon should rescrub before moving to the chest (Wells et al., 1983; Farrington et al., 1985). High-dose, narrow-spectrum, peri-operative prophylaxis may further reduce infection with sensitive organisms, but this is as yet unproven.

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References

