LISTER REVISITED: SURGICAL ANTISEPsis AND ASEPSis

Perhaps the greatest single advance in the history of surgery, aseptic wound management, was conceived and advocated decades before bacteria were conclusively implicated in the genesis of wound suppuration and even before contagion was generally accepted. Although it was promulgated in the 1840's by Ignaz Semmelweis in Europe and Oliver Wendell Holmes in this country against bitter opposition, wide-scale acceptance awaited Joseph Lister's epochal studies of prevention of surgical-wound infection between 1865 and 1891.1 Noteworthy is the fact that Lister's enormous impact derived from his empiric and indomitable belief in chemical antisepsis (i.e., “against sepsis”). Initially applying compresses saturated in dilute carbolic acid (phenol) to contaminated wounds, he rapidly came to irrigate all wounds copiously with the solution and eventually even to aerosolize it throughout his operating theater. Much later in his career, caught in the groundswell from antisepsis to surgical asepsis (i.e., without sepsis) that dominated surgery in the late 19th century, Lister came to recognize the greater importance of his solutions as disinfectants — for the operative-wound site, the surgeon’s hands and the instruments, sponges and linens — and abandoned antiseptic aerosolization and even irrigation of the wound. His profound influence formed the basis for the ritual of surgical asepsis that has persisted to the present day.

Most further refinements of Listerian asepsis occurred in the 1890's: steam sterilization, masks, sterile gloves and garb for the surgical team and sterile drapes and gauze sponges for the wound.1 For the next half-century there were relatively few technologic advances aimed at prevention of operative-wound infection.

The availability of effective antimicrobials 40 years ago fostered hopes that wound infection could be reduced to an infinitesimal minimum. However, the results of early studies of antimicrobial prophylaxis in surgical procedures were contradictory and generally disappointing.2 Only in the past decade have prospective, carefully controlled studies such as those of Polk and Lopez-Mayor3 and others4-7 demonstrated conclusively that a brief course of systemic antimicrobics selected for efficacy against anticipated microbial contaminants and begun before operation can augment careful surgical technic and further reduce the rate of wound infection — primarily in operations associated with a high risk of intraoperative contamination and subsequent infection. Except in certain high-risk orthopedic procedures,4-7 the value of systemic prophylaxis in ultra-clean surgical procedures such as cardiovascular operations or craniootomy remains unproved. In neurosurgical operations, antimicrobial prophylaxis may even be deleterious.4 Preoperative suppression of bowel flora with oral antimicrobial combinations such as tetracycline and neomycin has recently also been shown in a well controlled study to reduce substantially the high rate of wound infection in intestinal operations.8 With recent reports showing both antimicrobics9-12 and an iodophore antiseptic13 applied topically to the surgical wound before closure confer protection, we seem to have come full-circle back to early-Listerian antisepsis. The steady successes of antimicrobial prophylaxis must not overshadow the basic role of surgical asepsis.

Two large studies of surgical wound infection in the past 15 years, each comprising 15,000 to 20,000 patients operated on have identified host factors predisposing to infection and strongly re-emphasize the importance of meticulous surgical technic and uncompromising asepsis in prevention of infection.13,14 These studies and an increasing number of others15-17 have shown that micro-organisms introduced into the wound at the time of operation, of endogenous or extrinsic origin, underlie the vast majority of postoperative infections. Wounds in which microbial contamination (particularly >105 bacteria per gram17) can be demonstrated before closure are up to 18 times more likely to suppurate than culture-negative wounds. The dynamics of prophylactic antimicrobial efficacy (viz., preoperative administration) are now clearer. Furthermore, technologic innovations that lessen intraoperative contamination should theoretically further reduce the frequency of infection.

Three papers by Raahave18-20 call attention to the current quest for improvements in the technology of surgical asepsis. Using sterile gauze pads similar to those introduced 25 years ago by the Lederbergs in their replica plating experiments, Raahave has developed a simple and nov-
TRANSPANTATION OF MASSIVE BONE ALLOGRAFTS

The attempt to preserve a functional limb in treating low-grade malignant bone tumor presents a surgical challenge to anyone who must deal with such tumors. Surgeons have, after local resection, used prosthetic implants, massive autogenous transplants, with or without arthrodesis, or massive allografts. Elsewhere in this issue of the Journal, Mankin et al. report on 15 patients followed for an average of almost two years after receiving massive allografts. They quite correctly state clearly and positively that the report is a preliminary one and the procedure is experimental because of the many problems. The reports of Parrish, Ottolenghi, and Volkov indicate modest success with the use of musculoskeletal allografts, which in their experience was fraught with numerous complications.

The large mass of transplanted necrotic bone presents the major problem, since both autogenous or allograft bone may undergo fracture or destruction during the repair process. Parrish reported fracture in eight of the implanted allografts. Transplantation of autogenous whole joints shows late destruction with repair. Similar joint changes have been described for allografts, but in a more delayed manner, both experimentally and in human beings.

The immunologic aspects of the problem are not as clearly defined in bone as for organ and tissue allografts. There is evidence of a delayed hypersensitivity reaction to bone as long as any foreign bone persists. This reaction is manifested by a cellular response. This cellular response can be decreased by pretreatment of the laboratory animal with extracts of donor bone, and the "take" of the graft improved. However, the repair process still remains slower than that of autogenous bone. The cartilage component of a half-joint or a whole-joint allograft does remain immunologically privileged, but only as long as there is no circulation to the cartilage. Once joint breakdown occurs, with vascular invasion of the subchondral cortex or surface by pannus, the cartilage does react. This response is well known to surgeons who use cadaver cartilage for rhinoplasty.

Recent reports of attempts to use vascularized musculoskeletal allografts comparable to organ transplantsations suggest a possible solution to the two major problems cited above. Slome and Reeves, Reeves, and Judet and Padovan have performed allotransplantation of a whole joint on a vascular pedicle, with and without use of immunosuppression. Their studies in laboratory animals suggest that viability can be maintained and that the immunologic reaction to the tissues may be suppressed with appropriate treatment. Long-term experiments of this type are needed before any attempts to perform such a procedure on human beings.

For the present, one must accept the fact that massive musculoskeletal allotransplantation as currently employed is experimental. Its use should be limited to selected patients who have full knowledge of the risks involved and the various alternative methods available, and recognize that removal or amputation may ultimately be needed. These risks are as follows: (1) infections occur frequently in any major resection procedure with or without allograft replacement;
el technique to obtain quantitative surface cultures of the cut surface of the operative wound. Unfortunately, it is not compared with other, more tested methods of quantitative wound culture. Recently, Raahave has described a modification of the technic, eluting microorganisms from the pad into liquid medium. Although more sensitive, the modification is also more cumbersome.

Quantitative bacteriologic culture of surgical wounds, which has been studied intensively by Krizek and Robson and their co-workers, has been shown to be of value clinically for distinguishing infection from colonization of burn wounds and in guiding decisions regarding closure and skin grafting of contaminated wounds. In general, greater than 10^6 organisms per gram of tissue is predictive of infective morbidity and, in the latter two clinical circumstances, portends subsequent suppuration and graft failure respectively. Unfortunately, the techniques of quantitative wound sampling used in these studies are somewhat cumbersome (requiring wound biopsy, homogenization of tissue and serial pour-plate cultures), and quantitative bacteriologic culture of surgical wounds has not attained widespread use except in burn centers. If Raahave's method or a simple modification could be shown to give results comparable to these more defined methods, quantitative bacteriologic culture of surgical wounds could conceivably advance into the realm of clinical practicality, alongside quantitative culture of the urine.

However, studies by Robson and his co-workers suggest that quantitative culture of surface specimens (in contrast to samples of biopsied tissue) does not reliably show the status of surgical wounds so far as infection is concerned.

A means for reliable enumeration of bacterial densities also provides a useful tool for studies of the epidemiology of intraoperative contamination and of a new technology of asepsis. Raahave specifically uses his assay to identify the contrasting sources of wound contaminants in clean and clean-contaminated operations. In the two companion papers, he employs quantitative surface culturing in a small number of patients to evaluate the following points clinically: 1) a detergent-disinfectant combination (aqueous cetrimide, 0.15 per cent, and chlorhexidine, 0.015 per cent, followed by 0.5 per cent chlorhexidine in alcohol); and 2) the microbial-barrier efficacy of sterile disposable surgical plastic drapes, including an adhesive skin drape and a wound drape. The latter method, which shields the wound edges, uses a flexible ring that is inserted into the body cavity.

The disinfectant and the wound drape both show promise in terms of substantially reducing bacterial contamination as measured by the quantitative assay. Unfortunately, the antiseptic combination is not tested against other commonly used cutaneous disinfectants such as hexachlorophene, alcohol or iodine-containing agents. Although the combination is widely used in Europe, it is not available in this country. Both components have variable efficacy against pseudomonads, and under certain circumstances, these organisms can proliferate in the detergent solution. Outbreaks have been traced to such contamination. Raahave's disinfectant combination must be compared with conventional agents in large-scale clinical trials before it can be considered for release in this country.

Large, controlled clinical trials of adhesive plastic skin drapes in a number of institutions have not shown a reduction in the rate of infection. The impermeable wound drape, however, was found beneficial in one controlled study and seems worthy of further clinical evaluation.

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