

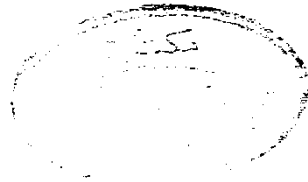
THE PROCEDURES INFLUENCING
POST-OPERATIVE
WOUND INFECTION

ESSAY

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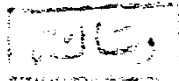
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CONTENTS

INTRODUCTION	1
SOURCES OF AND TRANSMISSION OF ORGANISMS	2
WOUND INFECTION IN SURGICAL WARDS	5
ROUTES OF THEATRE WOUND INFECTION	8
BASIC PROCEDURES	16
STAFF PROCEDURES	28
HOUSEKEEPING PROCEDURES	46
STERILIZATION & DISINFECTION	52
SUMMARY	61
REFERENCES	65
ARABIC SUMMARY	

INTRODUCTION

The term infection is generally used to mean the deposition and multiplication of bacteria and other micro-organisms in tissues or on surfaces of the body where they can cause adverse effects.

Sepsis means the presence of inflammation, pus formation and other signs of illness in wounds colonized by micro-organisms, and in tissues to which such infection has spread.

Clinical wound infection (sepsis) occurs in a small proportion of patients having operations on "clean" areas (e.g. soft tissues, muscles, bones). Such infections are often exogenous, i.e. acquired from external sources by cross-infection or due to contamination with bacteria from the inanimate environment; many are caused by *Staphylococcus aureus* and related bacteria.

Operations on hollow viscera, especially the colon and rectum which contain enormous numbers of bacteria, have a higher incidence of post-operative wound infection. Most infections following such operations are endogenous and caused by the patient's intestinal flora, the predominant species present being the anaerobic non-sporing bacillus, *Bacteroides fragilis*; *Escherichia coli* and other aerobic Gram-negative bacilli are also abundant.

(Lowbery & William , 1982)

SOURCES OF AND TRANSMISSION OF ORGANISMS

STAPHYLOCOCCUS AUREUS

The reservoir is the anterior nares from where organisms are conveyed to the skin of the hands. The hands and perineum are areas on which staphylococci tend to multiply with greatest readiness. The organisms are excreted either from overt lesions like boils and pustules, or else they may be discharged from the skin of symptomless carriers. The nose is the ultimate reservoir, but is of less importance in the actual transmission of the organism, except perhaps during heavy breathing and snorting.

The staphylococci are transferred either by direct contact on to a patient, or else to objects that may come into contact with patients fomites. A perineal carrier is very liable to contaminate his bedding. A carrier may also contaminate a communal bath or bowl.

The excretors of staphylococci may contaminate the air around them both directly and indirectly from their sheets and blankets. It is well recognised that movement in bed increases the number of organisms in the surrounding air.

Airborne staphylococci are particularly liable to contaminate the wounds in the operating theatre, where the area

of incision must of necessity be exposed for some time ; even in a ward these bacteria can contaminate wounds while they are being dressed. Furthermore, staphylococci will almost certainly be inspired by other patients and attendants, whose anterior nares may then be colonised. In this respect it is most important to note that a considerable amount of staphylococcal auto-infection from the nose is really the result of cross infection at a slightly earlier period. Many patients become nasal carriers during the pre-operative period, and subsequently contaminate their wounds.

STREPTOCOCCUS PYOGENES

The reservoir is the throat, but it is particularly those people who harbour streptococci in their noses who are likely to transmit infection. The important mode of transmission is by close direct contact. Unlike staphylococci, these organisms do not survive long on the skin, nor is the transmission of infection by fomites of much importance.

There is good experimental evidence that blankets which are heavily contaminated with streptococci do not infect people who sleep in them. The part played by airborne transmission in streptococcal cross infection is also not of great importance, except perhaps in extensive burns.

GRAM-NEGATIVE INTESTINAL BACILLI

Esch.coli is a universal commensal of the bowel, and Proteus organisms are present in about a third of all the specimens of faeces. It is probable that a considerable

amount of wound infection caused by these organisms is the result of true auto-infection.

The Gram-negative intestinal bacilli can be shed quite easily into the air, but they are much less resistant to drying than are the staphylococci and streptococci. Therefore airborne spread is not so important as with these cocci. On the other hand, stagnant water affords a suitable environment for the Gram-negative organisms, *Ps. aeruginosa* which has been known to contaminate the humidifiers of operating theatres (Walter & Israel, 1979) .

WOUND INFECTION IN SURGICAL WARDS

The modes of staphylococcal wound infection in a ward are not very different from those in a theatre, except that many other patients are also present. They are potential sources of infection.

Patients with obvious septic lesions and those suffering from staphylococcal pneumonia or enterocolitis are particularly dangerous. The organisms soon contaminate the beds, and are shed into the air.

It must be reiterated that much post-operative wound infection due to organisms in the patient's nose or on his skin is really the result of initial cross infection and subsequently auto-infection.

Quite apart from direct implantation into the wound, it is possible that the nasal carriers are subjected to a period of bacteraemia during the inexpert insertion of endotracheal tubes. The tissue damaged in the wound could be sufficient to localise infection there (Walter & Israel, 1979)

* ISOLATION POLICY

Under ideal circumstances all patients harbouring staphylococci should be isolated from the remainder of the hospital community, but in practice this is impossible.

There is no doubt, however, that patients suffering from extensive, discharging, staphylococcal lesions should be separated from uninfected patients (Hospital Infections Program , 1981) .

* DRESSING TECHNIQUE

Nurses who have infected lesions should not dress wounds. All dressers should be properly clothed and masked and a rigorous "no-touch" technique should be employed by the use of sterile forceps. Alternatively gloves should be worn.

It is a bad practice to dress wounds in general wards even if there is no evidence of overt infection among the patients. It is far better to use separate, well-equipped, properly ventilated dressing rooms (Walter & Israel, 1979).

It is important that sterilised dressings which have been exposed to the air should be discarded if not used at the time of exposure. It is a bad practice to keep a large supply of dressings in a metal drum , using some as required and keeping the remainder. If small packages are used, there will be less temptation to retain any dressings that are left over (Cruse ,1981).

Most dressings are occasionally removed for the wound to be observed and, if necessary, treated. A recently developed transparent, semipermeable membrane dressing is being promoted for use on wounds because the dressing does not need to be removed for the wound to be observed (Hospital Infections Program, 1981).

Wound dressings should be placed in paper bags and burnt. They should not be left lying around the wards. Used instruments should be sterilised without delay, and dirty bedclothes should be sent to the laundry as soon as possible (Cruse , 1981) .

ROUTES OF THEATRE WOUND INFECTION

I. OPERATIVE TEAM

In the operating room, the operating team is the greatest single source of airborne contamination (Putsep, 1979). Shaw et al (1973) stated that the increase in bacterial density is linked more to the activity of the surgical team present than their number.

Although the respiratory tract of the operating room staff, particularly the nasopharynx, is frequently considered as the main source of pathogenic organisms connected with post-operative wound infection, bacteria emanating from the nasopharynx constitute only a small fraction of the total shed, and the hands and noses of the team very rarely yield the strain found in the wound (Putsep, 1979).

Dineen (1973) stated that hair is perhaps a more common site than the nasopharynx for colonization by staphylococci. However, more micro-organisms have been found on the forehead than on the bordering hair. Also Putsep (1979) stated that the angle of the jaw, frequently uncovered in the operating room, has been found to be heavily contaminated. The highest counts of micro-organisms have been found on the head, neck, axilla, hands, perineum, groin and feet. Of these areas, the head and neck are singled out as a prime source of bacterial contamination.

Walter & Israel (1979) showed that the surgeon may have overt infection on the hands or some other part of the body, or more likely be a nasal carrier with contaminated hands. The most dangerous areas for transmitting staphylococcal infection are the hands and wrists. Even the most scrupulous 'scrubbing up' cannot sterilise the skin, for some organisms are bound to find shelter in skin pores.

The sweat that accumulates under the glove is bound to contain many organisms. The area of the wrist just above the rim of the glove is also dangerous. The sleeve of the theatre gown soon becomes sodden with blood, and organisms can penetrate it with ease, and so be introduced into the wound. By contrast, the nose is less dangerous as an immediate source of infection, but should be masked in order to obviate the danger of violent expulsion of droplets during sneezing or coughing.

II. AIRBORNE TRANSMISSION

The importance of airborne transmission as a source of post-operative is still controversial. Today's consensus holds that airborne organisms are important only in causing infection when an air-handling system is grossly contaminated. Contamination of air is not absolute condition for the occurrence of infection. Clean air by itself has been unable to reduce infection rate below 1.5% (Putsep, 1979).

It was demonstrated that the bacterial count in the air during the operations was $413/\text{m}^3$ in the conventionally-ventilated and $4/\text{m}^3$ in the laminar-flow room and the average number of bacteria washed from the wound at the end of the operations was 105 and three, respectively. These facts do suggest that 98% of bacteria in the patient's wound after surgery in the conventionally-ventilated operating room, came directly or indirectly from air.

It was also ascertained that the minority of bacteria in the wound fell directly from air (perhaps 30 %) ; the remainder presumably fell on to other surfaces and were transferred indirectly to the wound by other routes.

Analysis of the relationship between the number of bacteria washed from the wound at the end of operation to both the number of bacteria in the air of the operating room and those on the patient's skin at the wound site, clearly showed that the most important and consistent route of contamination was airborne (Whyte et al, 1982).

III. THE PATIENT

A pilot study has indicated that of the 112 host factors (endogenous factors) considered, there were 11 factors which showed a serious post-operative infection, and the greater the number of these risk factors, the greater is the risk of post-

operative wound infection. These factors were: malnutrition, malignancy, diabetes, alcoholism, anaemia, hypo-albuminaemia lymphopenia, abnormal immunoglobulins, exposure to steroids and/or cytotoxic drugs, abnormal results of delayed hypersensitivity skin test, and the presence of pre-operative bacterial contamination (Putsep, 1979).

Kune et al (1983) showed that of 200 patients, 6.5% were skin carriers of *Staphylococcus aureus* and 3.5% became skin carriers after admission. Development of the skin carrier state was associated with a long pre-operative hospital stay. Skin carriers of *Staph . aureus* had a significantly higher subsequent staphylococcal wound infection rate than non-carriers; nose and /or throat carriers of *Staph. aureus* did not. Pre-operative wound contamination was a significant factor in the subsequent development of wound infection.

The contamination of the skin around the wound area, the extreme of age, and the site of the operation (near the groin or perineum), have been found to be more important in wound infection. Also contaminated and drained wounds are more liable to infection than clean undrained ones (Putsep, 1979).

The shorter a patient's stay in a hospital before an operation, the less likely he is to develop a wound infection.