MANAGEMENT OF INFECTED TOTAL KNEE ARTHROPLASTY

An Essay

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First and for most thanks to God.

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The restoration of form and function of a severely arthritic knee has enticed surgeons since the nineteenth century. However, the most significant developmental era, the last 30 years. *(Scott, 1982)*.

Total replacement of disabled knee articulations by prosthetic components has been commonly used. However, infection of these prostheses involves both joint space and bone in a septic process that is a major clamity for the patient. *(Brause, 1984)*.

Deep infection represents the most severe complication of total knee arthroplasty. It significantly comprises knee function and it requires a considerable expanditure of the patient's and surgeon's energy to treat this problem definitively. The successful outcome of treatment depends on adequate clinical and laboratory assessment. The optimal treatment of deep infection after total knee arthroplasty remains complex and controversial. *(Windsor, 1991)*.

AETIOLOGY

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Generally speaking, wound infection may be defined as the body's response to the replication of bacteria in the body tissues. Infection is a net result of successful invasion by an army of bacteria that defeats an army of host defense mechanisms. *(Schurman et al., 1975).*

Infection may be superficial i.e. limited to the soft tissues, or deep i.e. deep to the fascial planes and involving the implant. *(Eftekhar 1984).*

Superficial Infection:

It includes infection of soft tissue till the deep fascia. Regardless the extent of involvement, infections not involving the prosthesis are not considered deep. Redness of the skin edges and defective healing observed at the time of first dressing are considered minor superficial infection. Necrosis of skin edges or discharge from the wound may be present. However, reddness may be the only sign of superficial infection. *(Eftekhar 1984).*

Deep Infection

These are infections affecting the deep fascia and deeper structures involving the implant.It is usually the result of bacterial contamination in the operating room. It may develop as a result of haematogenous seeding from a primary focus of infection elsewhere in the body. It is of great importance to distinguish the superficial from the deep wound infection as early as possible. In doubtful cases surgical exploration of the knee would be done to establish the correct diagnosis.*(Eftekhar 1984).*

Lidgren and Lindberg 1974 summarised the characteristics of both superficial and deep infection as follow:

** Superficial infections are characterised by :*

(a) Minor or absent systemic manifestations.

(b) Small amount of pus discharge.

(c) No bony infection could be seen on X-ray.

(d) Short time of resolution.

(e) Does not need operative intervention.

** Whereas deep infections are characterised by:*

(a) Systemic manifestations are usually present.

(b) Profuse pus discharge .

(c) Usually shows signs of bone infection in X-ray.

(d) Takes long time to be resolved.

(e) Usually needs operative drainage.

Mode of Infection:

Deep periprosthetic infection in total knee arthroplasty has been thought to be the exogenous introduction of bacteria at surgery. However, it may be due to the presence of haematogenous or metastatic infection of knee prosthesis by transient bacteria arising from distant sites. Deciding which is responsible, latent perioperative or late haematogenous could not be achieved.*(Insall and Thompson 1984).*

The haematogenous route is responsible for approximately 40 per-cent of infection. The remaining 60 percent could be occurred through contamination of the knee during operation *(Brause 1982).*

The perioperative infection may be presented early (less than three months after surgery) or late (more than three months after surgery) with either acute and generalised illness or indolent localised knee pain. *(Insall and Thompson 1984).*

Contamination During The Operation

Wound infection can result from contact with contaminated air. A clean-air environment in the operating room combined with meticulous surgical technique can reduce the incidence of infection after primary arthroplasties in osteoarthritis to o.5 percent by eliminating the transfer of microorganisms from the operating team to the wound. *(Glynn and Sheehan 1983).*

Clean-air in the operating room is a major factor to prevent infection in operations in-general. All precautions must be taken to ensure clean-air in the operating room. Clean-air reduces the infection rate up to 1.5 percent. The further reduction below 1.5 percent is attributed to other measures taken to avoid penetration of bacteria through the textile of the surgeon's operating gown and to improved methods of wound closure. *(Charnley 1972).*

Charnley attributed the decrease in the infection rate from 9 per cent prior to 1960 to less than 1 percent in 1970 in total hip replacement operations to the introduction of laminar air flow and personal isolator suits. Horizontal laminar air flow increased the risk of infection from 1.4 percent to 3.9 percent in total knee replacement operations. Indeed, horizontal laminar air flow system has resulted in a higher incidence of infection than would be expected with conventional operating theatres.This difference in the effect of laminar air flow on hip and knee arthroplasty was attributed to the position of the surgeon who must stand directly over the wound in knee surgery. *(Salvati et al, 1982).*

Reduction of airborne bacterial concentrations were accomplished using better air filtration combined with higher air turnover rates in a relatively small confined space (the "greenhouse"). By using personnel-isolater systems, bacterial shedding and dispersal by scrubbed personnel in the operating room were greatly reduced. The laminar-airflow clean rooms were developed by *Whitfield in 1961* to eliminate airborne radioative microparticulates.

Laminar-airflow clean room is characterized by the following features

1- A blower system.
2- A plenum that is pressurized by the blower system.
3- High-efficiency particulate air (HEPA) filters through which the pressurized air is forced.
4- Walls to keep air coming from the filters directional.
5- Vents to exit air to the outside environment or a duct system to recirculate air back to the plenum.

The HEPA filters usually remove airborne particles 0.5 micrometer or greater in size with an efficiency of 99.97 percent. Since almost all individual bacteria are larger than 0.5 micrometer and since all airborne bacteria are agglomerated on particles larger than 0.5 micrometer, the air that comes from the HEPA filter bank is sterile. Airflow velocity in the clean room is usually adjusted to 80 to 100 feet per minute or about 1 mile per hour. This velocity produces an air turnover rate of approximately 500 times per hour, compared to 25 to 40 times per hour in conventional operating rooms. In the clean room, this rapid air-exchange rate both dilutes and elutes bacteria shed into the air by personnel in the clean room. Airflow direction may be from ceiling-mounted plenums for vertical flow or wall-mounted plenums for horizontal flow. Turbulance in the airflow stream is produced by any obstructions, but the washout time is about 15 seconds and, since the turbulent air is essentially sterile, it makes little difference in the effectiveness of clean rooms. *(Nelson, 1984)*.

The maintenance of good operating room conditions is important to prevent infection. Airborne contamination in the operating room is increased by heavy traffic of personnel and equipment and maintenance of large numbers of persons in the operating room. *(Nasser 1992)*.

The primary and main sources of bacteria in the operation room are the staff and the patient. The concentration of bacteria in the operating room is directly proportional to the activity of and the number of people present. There are inevitably large numbers of colony-forming units given off by all normal individuals at all times. At rest 100.000 particles are given off per hour, moderate movement increases this to 1.000.000 per hour, and full body movement increases emission to 2.000.000 per hour. Conventional operating gowns do little to suppress body emissions. Impervious body exhaust gowns can remove all of the body emissions. *(Learmonth 1993)*.

Haematogenous Route

The mechanical stimulation of any soft tissue harbouring bacteria can elicit haematogenous infection elsewhere. Thus any trauma or manipulation of a region with a known constant bacterial flora. For instance, dental extraction or cystoscopy carry the risk of releasing bacteria into the bloodstream. In such condition, the initial operation was free of clinical evidences of infection. After incidence of infection via the haematogenous route, the patient experiences a definite febrile illness and acute joint pain denoting infection of the knee prosthesis. *(Stinchfield et al., 1980).*

Glynn and Sheehan 1983, mentioned other possible causes of haematogenous route infection. Gastrointestinal tract, inflammed gall bladder, genitourinary tract, parotitis, septic throat, dental work, and respiratory tract infection such as lobar pneumonia.

BACTERIOLOGY OF INFECTION

A wide variety of different organisms can be haematogenously seeded on implant. Of the forty studied cases of infected total knee replacements, *Bigliani and Stinchfield 1984,* isolated Gram-positive (+ve.) organisms in thirty two joints and Gram-negative (- ve.)organisms in eight cases. Over half the organisms identified were of the staphylococcal species (table 1). This is probably because of the ubiquitous nature of this organism. Furthermore, it is a common member in many of the normal flora of various body areas. Many of the organisms isolated are usaully present in the normal bacterial flora of the human body. Recently there are rare and anaerobic orgnisms being involved with haematogenous dissemination. This is particularly true in the compromised host. Bacteroides fragilis is an anoerobic gram - negative bacillus that is present primarily in the lower gastrointestinal tract that may seed on the joint . Isolation of both Pasteurella multocida and Aeromanas hydrophila were quite unusual . Pasteurella multocida is a gram - negative bacillus that is known to infect warm - blooded animals and is capable of causing a haemorrhagic septicaemia in humans who were bitten by domestic animals . The organism is frequently found in the oral and respiratory tracts of cats and dogs. Aeromonas hydrophila, also a gram - negative bacillus , is found