بسم الله الرحمن الرحيم

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بقسم التوثيق الإلكتروني بمركز الشبكات وتكنولوجيا المعلومات دون أدنى مسئولية عن محتوى هذه الرسالة.

ملاحظات: ....

A Systematic Review / Meta-Analysis in Management of infected long bone fractures of lower limb after intramedullary nailing in adults

Submitted for Partial Fulfillment of Master Degree in Orthopedic Surgery

By

Beshoy Mohsen Amin

M.BB.Ch

Under supervision of

Prof. Dr. Tamer Abd Elmaguid Mohamed Fayyad

Professor of Orthopedic Surgery

Faculty of medicine - Ain Shams University

Dr. Mostafa Aly Elabd

Lecturer of Orthopedic Surgery

Faculty of medicine - Ain Shams University

Faculty of Medicine

Ain Shams University

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List of Abbreviations

Abb.	Full term
CRP	C-reactive protein
CT	Computed tomography
DAIR	Debridement, antimicrobial therapy and implant retention
DM	Diabetes mellitus
DNA	Deoxyribonucleic acid
ESR	Erythrocyte sedimentation rate
HIV	Human immunodeficiency virus
HTN	Hypertension
IAFF	Infection after fracture fixation
ICS	International Classification for Standards
MRI	Magnetic resonance imaging
MRSA	Methicillin-resistant Staphylococcus aureus
ORSA	Oxacillin resistance among Staphylococcus aureus
PCR	Polymerase chain reaction
PJI	Periprosthetic joint infection
PRISMA	Preferred Reporting Items for Systematic reviews and Meta-Analyses
REM	Random-effects model
WBC	White Blood Cells

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INTRODUCTION

Lower limb long bone fractures are severe injuries resulting from high energy trauma, usually from road traffic accident. Intramedullary nailing is considered the gold standard of treatment of closed and many open femoral and tibial shaft fractures due to its biological and biomechanical advantages.[1]

The development of intramedullary sepsis after fixation of long bones is a dreadful complication. [1]

There are many risk factors that may lead to such an unwanted condition some of them related to the patient, other factors related to the fracture.

Only a few studies exist to report on the management of infection following IM nailing.[2]

The management depends on the timing of diagnosis of the infection, early diagnosis different from delayed infection.

It's important to consider that the early detection of such condition play a great role in determining different types of management and avoid deterioration of the patient, this helps in early recovery for the patient, and saves time and effort for both patient and surgeon, and decrease the cost bill for health care to society.

Many strategies are considered; debridement with antibiotic administration, nail removal and exchange with antibiotic coated nail or ilizarov frame.

AIM OF THE WORK

The present study is aiming to evaluate the effect of different methods of management of infected nail femur and tibia at different stages of infection.

REVIEW OF LITERATURE

Pathogenesis

Bacterial colonization of orthopaedic implants is a necessary, but not in itself sufficient, in the development of implant-related infection, one study reveals that patients who underwent elective removal of nail were cultured and cultures from 50% of the implants grew organisms. Therefore, bacteria may colonize implants without causing sepsis, and other factors besides the mere presence of bacteria must underlie the development of clinical infection.[3]

Other factors that must be considered include the formation of a **Biofilm**, biofilm is formed due to the adsorption of proteins, sugars, and other macromolecules onto the implant surface; possible changes in the material itself attributable to the host or the bacteria; the effects of the implant on the local environment; and the systemic effects of the implant in the host. [3]

Bacterial adhesion proceeds through two stages. First, nonspecific physicochemical forces result in an initial, reversible attachment of the bacterium to an available surface. Once the bacterium is attached to the substrate, molecular reactions between bacterial surface macromolecules and substrate surfaces result in permanent adherence to the surface. Fibronectin is a protein that modulates surface adhesion of eukaryotic cells and has been shown to promote S aureus adhesion as well.[3]

The Race for the surface theory, a freshly implanted device presents a highly reactive surface destined for one of two fates: bacterial adhesion and colonization or tissue integration. If eukaryotic host cells integrate themselves into the surface first, bacterial colonization will be actively inhibited, and the biomaterial will become tissue-integrated. If bacterial cells colonize the surface first, a so-called microzone may be established that is conducive to further bacterial growth and inhibits any immune response. A key feature of this process is the formation of slime, a mucopolysaccharide biofilm that enhances bacterial nutrition, interferes with phagocytosis, influences antibody function, and promotes further bacterial aggregation.[3]

The production of one type of this so-called slime, bacterial glycocalyx, is an important determinant of antibiotic resistance. Firoozabadi et al. [4] reported that 76% of implants retrieved from patients with prosthesis-related infections had causative bacteria enclosed in a glycocalyx biofilm. The mature biofilm consists of both the accumulated bacterial mass and associated extracellular glycocolyx. [4]

Types of bacteria

Biofilm and planktonic bacteria account for two main phenotypes that are encountered in medicine. Planktonic bacteria are free floating, have a high metabolic rate, and divide rapidly. As a result, they are susceptible to the surrounding hostile environment, including systemic and local antibiotics

and phagocytes. In contrast to the planktonic phenotype, the biofilm phenotype is characterized by a protected mode of growth in which bacteria undergo a metamorphosis into a multicellular organism that provides for its survival in an unfavorable environment as an adherent form at the expense of individual cells (Figure 1). Specific structures that allow cross-talk between different regions form in the biofilm, and channels allow for the transport of nutrients. Biofilm bacteria also produce an extracellular matrix that provides a protective coating to withstand shear stress and guard against an external biocidal environment.[4]

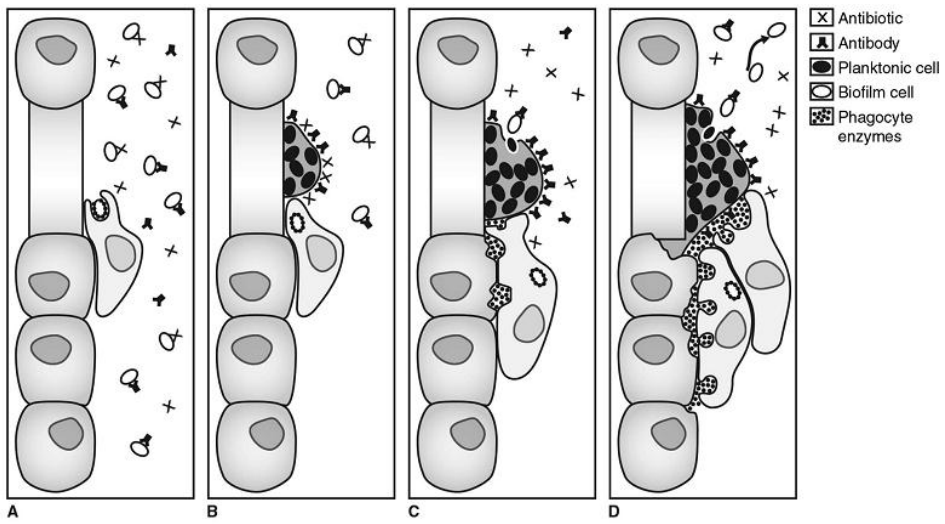

Figure (1): Medical biofilm diagram. A, Antibodies and phagocytes can clear planktonic bacteria, which are vulnerable to antibiotics. B, Biofilms are formed by adherent bacterial cells on inert surfaces, which make for sessile communities that are resistant to antibodies, phagocytes, and antibiotics. C, Phagocytes bind to biofilms, but the process of phagocytosis does not occur, even though phagocytic enzymes are released. D, The tissue that surrounds the biofilm is damaged by these phagocytic enzymes. This results in the release of planktonic bacteria from the biofilm, which can spread to neighboring tissue. [4]

Risk Factor for Infection

Risk factors for infection after orthopaedic trauma include patient-related factors (eg, smoking, diabetes mellitus, poor nutrition, homelessness, compromised immune status, vascular disease) and injury-related factors such as open traumatic wounds, soft-tissue loss, and vascular damage. The most important factor in predicting infection was the presence of an open injury.[5, 6]

According to the patient:

- Age: patients >30 years old are more liable to infection than younger ones.[7]
- Gender: some statistical studies found that males are at high risk of infection than females. [7]
- Body mass index: morbid obesity patients suffer from several problems including late and difficult manipulation leads to high risk of bed sores and infected surgical wounds. [7]
- Past history of chronic illness: this could be the most critical risk factor, uncontrolled DM, HTN or chronic liver or kidney disease are main reason for law immunity and increase bacterial growth post- operative. [7]
- Septic focus: bacteria could infect the wound from any other missed septic focus in patient's body. [7]
- Immunocompromised pt: any cause decreasing WBC count and antibodies in blood like HIV disease and leukemia make the patient vulnerable to get infected easily. [7]

- Smoking. [7]
- Drug abuse. [7]
- Low social economic patient: the lack of infrastructure and the higher rate of malnutrition and immunosuppression in low-income countries leads to an increased risk of infection. [7]

Injury related factors:

- Open fractures: Infection risks also differ by fracture type and have been reported to be ranging from 0 to 2% for Gustilo Type I fractures, 2 to 10% for Type II fractures, and 10 to 50% for Gustilo Type III fractures. [8]
- Mood of truma: high energy accidents such as car accident in the majority (56%) of the patients cause more tissue damage and aggravate infection.[8]
- Soft tissue loss and vascular damage. [8]
- Iatrogenic:
    - Operative time.
    - Surgical skills. [8]