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Aim of the Work

The goal of this study is to determine the usefulness of prophylactic antibiotic in pediatric patients undergoing surgery.

Risk factors for infections in pediatric surgery

The risk of postoperative wound infection varies according to many factors that determine the occurrence of any infection as the microorganism, the environment, and the host defense mechanisms.

Generally, the larger the bacterial inoculum and the more invasive the organism, the greater the likelihood of infection. An environment that is moist or contains necrotic tissue enhances bacterial proliferation. Patients who are immunosuppressed often are unable to mount an immune response that localizes organisms to the site of entry; such patients are vulnerable to sepsis. **(Collier, 2006).**

I. Factors that influence the development of surgical Site infections:

(A)Endogenous Factors:

The human body contains about 10^{13} human cells and 10^{14} resident bacteria, thus for most SSIs, the source of pathogens is the endogenous flora of the patient's skin, mucous membranes, or hollow viscera. When mucous membranes or skin is incised, the exposed tissues are at risk for contamination with endogenous

flora. Other endogenous factors include; Age (elderly, neonates), Altered immune response (e.g. AIDS), Colonization with micro-organisms, Concurrent diseases (e.g. diabetes), Chronic renal failure. **(Friberg, 2006).**

(B)Exogenous Factors:

The healthcare worker's hands are the most common source of the transmission of micro-organisms in nosocomial infections. Other exogenous sources include; Contaminated or dirty surgical procedures, duration of operation, duration of surgical scrub, excessive movement of staff, foreign material in the surgical site. **(Friberg, 2006).**

The risk of SSI is increased by factors that:

- Increase the risk of endogenous contamination (for example, procedures that involve parts of the body with a high concentration of normal flora such as the bowel)
- Increase the risk of exogenous contamination (for example, prolonged operations that increase the length of time that tissues are exposed)
- Diminish the efficacy of the general immune response (for example, diabetes, malnutrition, or immunosuppressive therapy with radiotherapy, chemotherapy or steroids) or local immune response (for example, foreign bodies, damaged tissue or formation of haematoma). **(Neumayer et al, 2007).**

II. Factors control the risk for infection in pediatric surgery:

1- Nature of bacterial inoculum.

2- Patient general health state.

3- Local wound environment.

4- Nature of surgical procedure.

5- Preoperative use of prophylactic antibiotics.

6- Surgical theatre design and staff training.

7- Equipments.

(Collier, 2007).

1-Bacterial inoculum:

The pathogenicity and size of the bacterial inoculum is related to chance of developing SSI, the smaller the bacterial inoculum at site of contamination the more likely antimicrobial therapy will eliminate bacteria and Prevent infection.

(Shein et al, 1996).

2-Patient general health state:

Patient risk factors are summarized in the following:

1-Patient's age

2-Concurrent disease (e.g. diabetes)

3-Malnutrition

4- Skin diseases, particularly infections

5-Obesity

6-Cancer

7-Chemotherapy or radiotherapy

8-Trauma

9-Shock

10-Peripheral vascular disease

11-Smoking

12-Liver cirrhosis

13-Renal failure

14-Steroid therapy

15-Immunosupperssion

16->2-week preoperative hospitalization **(Collier, 2007).**

Adults generally have higher wound infection rates than those reported for children. Children have anatomic and physiologic advantages for healing without infection. Their delicate tissues *demand* gentle, meticulous handling. Their lack of subcutaneous fat facilitates dissection; most operations are completed in less than 1 hour. Hospital stays generally are short because young patients usually have a single diagnosis and young tissues heal quickly. Four predictors identified for wound infection: abdominal operations, wound classification as contaminated or dirty infected, operations lasting longer than 2 hours, and the presence of three or more diagnoses. Children are unlikely to have the latter two of these four risk factors. **(Haley et al, 1993)**

The relationship between infection and malnutrition: These are multiple mechanism of action in the relationship between malnutrition and susceptibility to bacterial infectious disease for instance protein calorie malnutrition (PCM) impairs normal immune system development **(Keusch, 2003).** Stimulation of an immune response by infection increases the demand for metabolically derived anabolic energy, leading to a synergistic viscous cycle of adverse nutritional status and increased susceptibility to infection (protein malnutrition increases prevalence of infection, leading to energy lose for the individual). Infection itself can cause a loss of critical body stores of protein energy, minerals and vitamins, during an immune response energy expenditure increases at the same time that the that the infected host experience a decrease in nutrient intake **(Keusch, 2003).**

The first line of defense against these types of infection is innate immune response, particularly epithelial barriers and the mucosal immune response **(Chapman I, 2006).** PCM significantly compromises mucosal epithelial barriers in the gastro intestinal, respiratory and urogenital tracks. For example, vitamin A deficiencies include the loss of mucus-producing cell. This loss of productive mucus blanket increases susceptibility to infection by pathogens that would ordinarily be trapped in the mucus and swept away, by cleansing flow of mucus out the body. Barrier

defects of mucous membranes are critical in the pathogenesis of respiratory and gastrointestinal tract infection **(Chapman I, 2006).**

3- Local wound environment:

The risk of infection varies by the type of surgical incision site. For example, invasive procedures that penetrate bacteria-laden body sites, especially the bowel, are more prone to infection. The traditional wound classification system designed by the CDC stratifies the increased likelihood and extent of bacterial contamination during the surgical procedure into four separate classes of procedures:

Clean **:** an operation in which no inflammation is encountered. The respiratory, alimentary and genitourinary tracts are not entered. There is no break in aseptic operating theatre technique. Primary wound closure is undertaken (e.g. sebaceous cyst excision).

Clean-contaminated **:** an operation in which the respiratory, alimentary or genitourinary tract is entered but there is no significant spillage (e.g. appendicectomy).

Contaminated **:** an operation in which acute inflammation (without pus) is encountered or where there is visible

contamination of the wound. For example, gross spillage from a hollow viscus during the operation or open/compound operations operated on within 4 hours. Operations in which there is a major break in aseptic technique also fall into this category (e.g. colorectal surgery).

Dirty **:** operations in the presence of pus or devitalized tissue, a previously perforated hollow viscus, or open/compound injuries more than 4 hours old. **(SIGN, 2008).**

The incidence of the surgical site infections according to wound class were recorded as :Infection rate was 3.9% in clean wounds , was 12.5% in clean contaminated wounds ,was 16%incontaminated wounds ,was 56.7% in dirty wounds. Thus there was clear correlation between the wound infection rate and the contamination of the wound. **(Mahesh et al,2010).**

4-Factors related to surgical procedures:

1-Wound classification.

2-The presence of foreign bodies as drains(open drainage system), prosthesis (orthopedic or vascular prosthesis) and suture material such as silk sutures increase chance of wound infection **(Cooper , Kingsley, 2003).**

Insertion of plastic biomaterials for example mesh insertion raises the possibility of wound infection. **(Falagas &Kasiakou, 2005).**

3-Site and complexity of procedure:

For many types of surgery there is evidence that the risk of SSI is affected by the specific site of the operation, for example cervical laminectomy is associated with a lower risk of SSI than laminectomy performed at other levels. **(Friedman et al, 2007).**

Complexity of the procedure is also indicated as an SSI risk factor. Two- to three-fold increased risk of SSI with increasing surgical complexity measured as work relative value units. However, complex surgery is more often distinguished by prolonged duration of the procedure. **(Neumayer et al, 2007).**

4- accidental spillage from bowel: increase the risk of the SSI.

5-excessive use of diathermy: increase the risk of the SSI ***(Rodd et al., 2007).***

6-long duration of operation :increase the risk of the SSI **(Falagas&Kasiacou, 2005).**

7-hemorrhage and haematoma .

Devitalized tissue, excessive dead space or haematoma, all are the results of poor surgical technique, increase the chances of bacteria to gain a foothold. **(Friedman et al, 2007).**

5-Staff, theatre design and planning: The following factors are associated with increase the incidence of SSI:

1-Staff with skin infections in the theatre.

2-Unrestricted movement of staff.

3-Inappropriate use of theatre clothing.

4-Open containers of solutions(saline and disifectants).

5-Inadequate operating theatre ventilation.

6-Simultaneous operations in the same room.

(Lipp&Edward, 2002).

6-Preoperative use of prophylactic antibiotics:

In the first 4 hours after a breach in an epithelial surface and underlying connective tissues made during surgery or trauma, there is a delay before host defenses can become mobilized through acute inflammatory (humoral and cellular) process. This period is called the decisive period and it is during these first 4 hours after incision that bacterial colonization and established infection can begin. It is logical that prophylactics antibiotics will be most effective during this time **(Cutting and Harding , 2005)**

7-Equipment

1-Inadequate sterilization/disinfection.

2-Re-use of inadequately processed invasive devices.

3-Inadequate training of nursing and medical staff.

4-Inapypropriate dressing techniques**. (Plowman , 2007).**

Table (1) Risk Factors for Infection in Pediatric Surgical Patients

Factors Affecting	***Increased Risk***	***Decreased Risk***
Microorganism	Large inoculum High pathogenicity Wound category: contaminated or dirty Operation > 1 hour Antibiotics poorly timed Prolonged antibiotics	Small inoculum Low pathogenicity Wound category: clean or clean-contaminated Operation < 1 hour Antibiotics 1/2 to 2 hours before incision Short course of antibiotics
Environment	Moist environment Necrotic tissue present Break in sterile technique Break in isolation technique Unprepared bowel (colon surgery) Central venous catheter Indwelling foreign bodies (eg, shunts,catheters) Invasive monitoring	Dry environment Viable tissue No break in technique No break in technique Bowel preparation Peripheral venous lines No indwelling foreign bodies Noninvasive monitoring
Host	Immunosuppression Emergency operation Multiple operations Associated illnesses Poor nutrition Neonates (sepsis) Neonatal bowel resection Breaks in skin	Immunocompetence Elective operation Single operation Single diagnosis Good nutrition Older infants, children (sepsis) Other neonatal operations Intact skin

(Bhattacharyya et al, 1993)

Sources of infections in pediatric surgery

Most SSIs are caused by the patient's endogenous flora, either from the skin (in particular Staphylococcus aureus) or from the site of surgery, but may be due to seeding from distant foci of infection, a particular problem if an implant or prosthesis is being used. Exogenous sources may also be a factor, such as infected or colonised healthcare workers, the operating room environment or instruments; in this instance aerobic Gram-positive organisms are usually responsible **(Scottish, 2008).**

I. Sources of surgical infection:

- 75% of nosocomial infections occur in surgical patients
- Most postoperative infections arise from patients own flora
- Commonest sites of infection are:
  - Urinary tract (40%)
  - Respiratory tract (15%)
  - Bacteraemia (5%)

Normal body flora

- Skin - staphylococci, streptococci
- Oral cavity - staphylococci, streptococci and anaerobes

- Nasopharynx - staphylococci, streptococci, haemophilus and anaerobes
- Large bowel - gram-negative rods, enterococci and anaerobes
- Urinary tract - normally sterile

Routs of wound contamination:

- Direct inoculation

  -Patients residual flora or skin contamination
  -Surgeon's hands
  -Contaminated instruments or dressings
  -Contaminated procedure
  -Drains, catheters or intravenous lines

- Airborne contamination

  -Skin and clothing of staff and patients
  -Air flow in operating theatre or ward

- Haematogenous spread

  -Intravenous lines
  -Sepsis at other anatomical sit. **(Leaper, 1999)**

II. Bacteriology of surgical site Infection:

Bacteria are normally prevented from causing infection in tissues by intact epithelial surfaces, but these broken down by

trauma and surgery. In addition to this mechanical barrier there are other protective mechanisms:

(a) Chemical (such as the low gastric pH).

(b) Humoral (antibodies, complement and opsonins).

(c) Cellular (phagocytic cells, macrophages, polymorph nuclear cells, and killer lymphocytes).

All these natural mechanisms may be compromised by surgical trauma. The risk of surgical site infection following an operative procedure is a result of bacterial contamination at the time of surgery **(Taylor, 2005).**

III. Bacteria involved in wound infection according to surgical procedures:

1-Clean operations:

Surgical site infections in clean procedures occur due to contamination by staphylococcus or streptococcus, as they are the most common encountered skin flora. Preoperative antibiotics must cover these bacteria especially in orthopedic, vascular, neurosurgical and cardiothoracic operations. As in these procedures infective complications is grave **(Bratezler&Houck, 2004)**.