



**Comparison between High versus Low
Fraction of inspired Oxygen on Incidence of
Postoperative Surgical Site Infection in
Abdominal Hysterectomy**

A thesis

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

قالوا

سبحانك لا علم لنا
إلا ما علمتنا إنك أنت
العليم العظيم

صدق الله العظيم

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Contents

Title	Page No.
List of Tables	5
List of Figures.....	6
List of Abbreviations	7
Introduction	1
Aim of the Work	4
Review of Literature	
▪ Surgical Site Infection	5
▪ Oxygen Therapy: A Double Edged Sword.....	20
▪ The Anesthesiologist's Role in the Prevention of Surgical Site Infections.....	32
Patients and Methods.....	38
Results	43
Discussion.....	49
Summary	55
References	57
Arabic Summary	

List of Tables

Table No.	Title	Page No.
Table (1):	Recommendations on oxygenation preparation according to available guidelines	9
Table (2):	Comparison between groups according to demographic data.....	44
Table (3):	Comparison between groups according to intraoperative PaO ₂	46
Table (4):	Comparison between groups according to post-operative infection.....	47

List of Figures

Fig. No.	Title	Page No.
Fig. (1):	Classification of surgical site infections according to CDC National Nosocomial Surveillance System	6
Fig. (2):	Sites of ROS production, diffusion, and action.....	19
Fig. (3):	Beneficial, and deleterious effects of hyperoxia, i.e., breathing pure oxygen, during circulatory shock and/or in medical emergencies.....	23
Fig. (4):	Bar chart between groups according to age (years).....	44
Fig. (5):	Bar chart between groups according to BMI.....	45
Fig. (6):	Bar chart between groups according to ASA.....	45
Fig. (7):	Bar chart between groups according to intraoperative PaO ₂	46
Fig. (8):	Bar chart between groups according to postoperative infection.....	48

List of Abbreviations

Abb.	Full term
AMR.....	Antimicrobial Resistance
ASA.....	American society of anesthesiology
ATP	Adenosine triphosphate
BMI.....	Body mass index
CBC.....	Complete blood picture
CBF.....	Cerebral blood flow
CDC	Centers for Disease Control and Prevention
CHG.....	Chlorhexidine gluconate
CO	Carbon monooxide
DCI.....	Decompression injury
ECG	Electrocardiogram
ESBL.....	Extended Spectrum beta-lactamase
EtCO ₂	End tidal carbondioxide
FiO ₂	Fraction of inspired oxygen
H ₂ O ₂	Hydrogen peroxide
HAI	Health care Associated Infection
HBO	Hyperbaric oxygenation
IDSA	Infectious Diseases Society of America
Km	Michaelis constant
MRSA.....	Methicillin resistant staphylococcus aureus
NADPH.....	Nicotinamide adenine dinucleotide phosphate
NICE.....	National Institute for Health and Care Excellence
O ₂	Oxygen
O ₂ ⁻	Superoxide radical
OH.....	Hydroxyl rdical
OR.....	Operating room
PaO ₂	Arterial partial pressure of oxygen
PVP-I	Povidone Iodine

List of Abbreviations (cont...)

Abb.	Full term
RCT.....	Randomized controlled trial
RNS.....	Reactive nitrogen species
ROS.....	Reactive oxygen species
SAP	Surgical Antibiotic Prophylaxis
SD	Standard deviation
SHEA.....	Society for Healthcare Epidemiology of America
SOD.....	Superoxide dismutases
SpO ₂	Oxygen saturation
SSI	Surgical Site Infection
TLC	Total leucocytic count
WHO	World Health Organization

INTRODUCTION

Infection is a major complication of surgical procedures, and among surgical patients, surgical site infection (SSI) is the most common nosocomial infection. SSIs prolong hospitalization, increase the cost of care, and are associated with excess mortality (*Al-Niaimi et al., 2009*).

The fight against such infections is a daily concern of surgical, anesthesiology, and infection control teams.

Surgical patients initially seen with more complex co morbidities and the emergence of antimicrobial-resistant pathogens increase the cost and challenge of treating SSIs. The prevention of SSI is increasingly important as the number of surgical procedures performed in many countries continues to rise. Public reporting of process, outcome, and other quality improvement measures is now required. It has been estimated that approximately half of SSIs are preventable by application of evidence-based strategies (*Umscheid, 2011*).

Multiple patient co-morbidities and risk factors, in addition to procedure-related risk factors, can impact the risk of SSI. SSIs result in increased morbidity and mortality. Direct and indirect costs from SSIs include increased hospital length of stay, readmissions for treatment including repeat surgical procedures, outpatient and emergency care visits, use of ancillary services, additional medications (including prolonged

antimicrobial therapy), lost productivity, and temporary or permanent disability (*Martin, 1997*).

Scientific societies have issued recommendations for reducing the risk of SSI. In addition to major preoperative prevention measures (antibiotic prophylaxis and preparation of the skin of the patient undergoing surgery), these recommendations include important peri and postoperative measures: management of body temperature, volemia, glycemia and postoperative pain. Hyper oxygenation is another theoretical preventive measure (*Thibon et al., 2012*).

Hypoxic wounds not only have a slower rate of healing but also a higher risk of developing infections proportionate to the degree of tissue hypoxia. Oxygen at the wound site is believed to be associated with heightened bactericidal activity of neutrophils through increased oxidative killing. Additionally, the activity of antibiotics might be enhanced at higher levels of oxygen (*Silvia et al., 2013*).

Although the global burden remains unknown because of the difficulty to gather reliable data, it is estimated that hundreds of millions of patients are affected by HAIs (health care-associated infection) each year, leading to significant mortality and financial losses for health systems. At present, no country is free from the burden of disease caused by HAIs and antimicrobial resistance (AMR) (*Brinkmann, 2004*).

Accordingly, the WHO and Centers for disease control and prevention (CDC) both published guidelines for the prevention of surgical site infections including preoperative, intraoperative and even postoperative measures. These guidelines should be implemented by all health care givers including the surgeons, anesthesiologists and nurses in the perioperative period and reassessed periodically.

AIM OF THE WORK

The aim of this study is to evaluate the effect of high inspired oxygen fraction supplementation on the incidence of surgical site infection in women undergoing elective abdominal hysterectomies compared to a group of patients receiving low inspired oxygen fraction supplementation intra-operatively.

Chapter 1

SURGICAL SITE INFECTION

World Health Organization (WHO) defined the surgical site infection (SSI) in its latest guidelines as an infection that occurs after surgery in the part of the body where the surgery took place. Surgical site infections can sometimes be superficial infections involving the skin only. Other surgical site infections are more serious and can involve tissues under the skin, organs, or implanted material (*Berrios et al., 2017*).

Surgical wounds are divided into four classes:
(according to the latest definition of the centers of disease control and prevention)

1. *Clean* refers to an uninfected operative wound in which no inflammation is encountered and the respiratory, alimentary, genital or uninfected urinary tracts are not entered.
2. *Clean-contaminated* refers to operative wounds in which the respiratory, alimentary, genital or urinary tracts are entered under controlled conditions and without unusual contamination. Specifically, operations involving the biliary tract, appendix, vagina and oropharynx are included in this category, provided no evidence of infection or major break in technique is encountered.

3. *Contaminated* refers to open, fresh, accidental wounds. In addition, operations with major breaks in sterile technique (for example, open cardiac massage) or gross spillage from the gastrointestinal tract, and incisions in which acute, non-purulent inflammation is encountered, including necrotic tissue without evidence of purulent drainage (for example, dry gangrene), are included in this category.
4. *Dirty or infected* includes old traumatic wounds with retained devitalized tissue and those that involve existing clinical infection or perforated viscera. This definition suggests that the organisms causing postoperative infection were present in the operative field before the operation (*Berrios et al., 2017*).

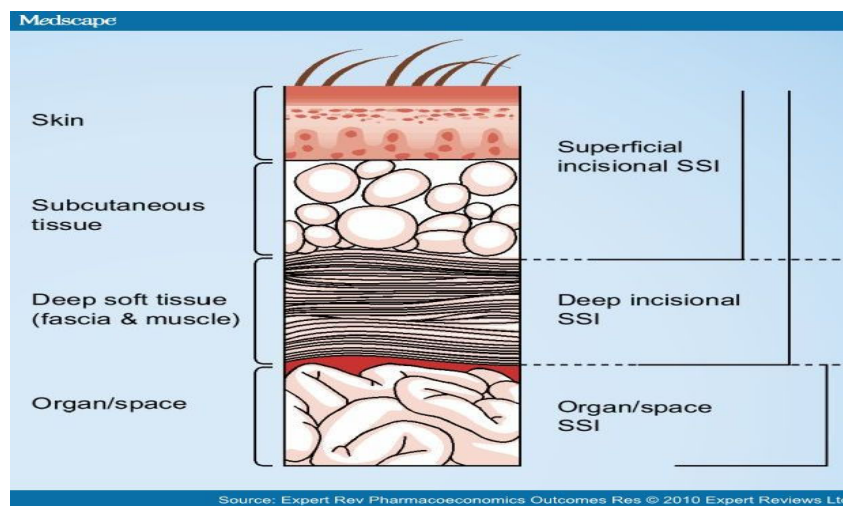


Fig. (1): Classification of surgical site infections according to CDC National Nosocomial Surveillance System. SSI: Surgical site infection (*Teena, 2010*).

Criteria of SSI:

1. Purulent discharge in or exuding from the wound or observed on direct examination.
2. Painful spreading erythema indicative of cellulitis.
3. Purulent drainage.
4. Purulent drainage from a drain placed beneath the fascial layer.
5. Purulent drainage from a drain placed through a stab wound into the organ/space.
6. Organisms isolated from fluid or tissue from the wound.
7. Organisms isolated from fluid or tissue in the organ/space.
8. Surgeon/physician diagnosis.
9. Surgeon deliberately opens wound, unless wound is culture-negative.
10. Wound spontaneously dehisces.
11. Pain.
12. Tenderness.
13. Fever $> 38^{\circ}\text{C}$.
14. Localized swelling (oedema).
15. Redness or extending margin or erythema.