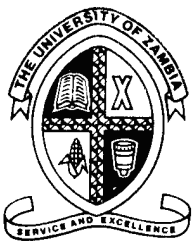

A CROSS-SECTIONAL STUDY OF RISK FACTORS ASSOCIATED WITH WOUND STRENGTH IN POST MIDLINE LAPAROTOMY HIV POSITIVE PATIENTS AT THE UNIVERSITY TEACHING HOSPITAL, LUSAKA

BY

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2016

DECLARATION

I hereby declare that this dissertation entitled ***RISK FACTORS ASSOCIATED WITH WOUND STRENGTH IN POST MIDLINE LAPAROTOMY HIV POSITIVE PATIENTS AT THE UNIVERSITY TEACHING HOSPITAL, LUSAKA*** represents my own work and has not been presented either wholly or in part for a degree at the University of Zambia or any other University elsewhere.

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CERTIFICATE OF APPROVAL

THIS DISSERTATION OF DR. MUTUNA CHIWELE IS APPROVED AS FULFILLING PART OF THE REQUIREMENT FOR THE AWARD OF THE DEGREE OF MASTER OF MEDICINE IN GENERAL SURGERY BY THE UNIVERSITY OF ZAMBIA.

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Examiners

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ABSTRACT

Introduction

Delayed-healing in abdominal surgical wounds may be detrimental to patients and the health care. The author set out to investigate the effects of CD4+ count, serum albumin and haemoglobin (HB) levels on wound strength in HIV positive patients. Wound strength in this study is used to determine the rate of wound healing.

Objectives

To determine some risk factors associated with post laparotomy wound strength and to investigate the relationship between CD4+ count and wound strength in HIV positive patients. To establish the prevalence of wound break down and to study other risk factors associated with wound strength in wound healing.

Methods

This was a cross-sectional study done from January to June 2014 at UTH Surgery Department. HIV positive patients who underwent abdominal surgery during the study period were enrolled to meet the sample size of 56. A structured questionnaire was used to gather information. Blood was drawn from enrolled patients for laboratory investigations namely CD4+ count, serum albumin and haemoglobin. On Day 10 post surgery wound strength was measured using a Digital Force Gauge. Data analyzed using frequency tables, correlation coefficient test and multiple linear regression analysis to determine associated factors.

Results

In this study wound tensile strength of patients 10 days after abdominal surgery ranged from 0.38 to 6.33N. The mean wound strength was 2.88 (SD=1.69030), the mode was 2.89N. The following factors were associated with wound strength; CD4+ count, serum albumin and haemoglobin (HB). Patients' CD4+ count ranged from 23 to 600 with a mean of 217.2679 (SD=131.57431), haemoglobin (HB) ranged from 5.4 to 14.2g/dl with a mean of 9.1286 (SD=2.14525) and serum albumin ranged from 13.0 to 49.0mmol/L with a mean of 29.1982 (SD=8.67629). Correlation coefficient test conducted at significant level of 0.01 showed that there was a significant positive association between CD4+ count and wound strength (rho=0.944 (n=56); p=0.001). There was also a significant positive association between haemoglobin (HB) and wound strength (rho=0.811 (n=56); p=0.001). The results further confirmed a significant positive association between serum albumin and wound strength (rho=0.711 (n=56); p=0.001). Multiple linear regression analysis was used to develop a model for predicting wound strength. The results showed that each of the predictor variables had a significant ($p<0.1$) zero-order correlation with wound strength, but only CD4+ count and serum albumin had significant ($p<0.01$) partial effects in the full model. The three predictor model accounted for 90.1% of the variance wound strength, $F(3, 52) = 157.398$, $p<0.001$, $R^2 = 0.901$, 95% CI [-1.157, 0.300]. The results showed that CD4+ count was the best predictor of wound strength followed by serum albumin.

Conclusion

Post laparotomy wound strength in HIV positive patients was significantly affected by CD4+ count, serum albumin and haemoglobin. Of the three predictors CD4+ count was confirmed to be the best predictor of wound strength followed by serum albumin and haemoglobin respectively.

DEDICATION

I dedicate my dissertation to Violet Zulu my future wife for her constant support during the most crucial time of my writing up of this piece of work. Thank you very much for understanding and according me a chance to have it completed in its best form. To you I say this is the product of your indirect work.

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CONTENTS

LIST OF TABLES AND GRAPHS

Tables **Page**

Figures

ABBREVIATIONS AND ACRONYMS

- **AIDS**- Acquired Immunodeficiency Syndrome
- **ART**- Antiretroviral Therapy
- **CIDRZ-** Centre for Infectious Diseases Research in Zambia
- **CD4+**- Cluster of Differentiation 4
- **FBC**- Full Blood Count
- **GRZ**- Government of the Republic of Zambia
- **HB**- Haemoglobin
- **HIV**- Human Immunodeficiency Virus
- **RDCTC**- Routine Diagnostic Counseling, Testing & Care
- **RNA**- Ribonucleic ACID
- **TB**- Tuberculosis
- **UTH**- University Teaching Hospital

DEFINITIONS OF KEY WORDS/PHRASES

1. **Delayed Wound Healing**: wound strength of less than 4.5N after 14 days of surgical operation after stitch suture removal or failure of skin cells to cover the surgical wound after 14 days of surgery.
2. **Haemoglobin**: protein molecule in the red blood cells that carries oxygen from the lungs to the body's tissues and returns carbon dioxide from the tissues back to the lungs.
3. **HIV Immunosuppression**: infection with HIV virus which reduces the activation or efficacy of the immune system leaving the body susceptible to opportunistic infections/conditions. Normally occurs with a CD4+ count below 350.
4. **Laparotomy**: surgical procedure involving a large incision through the abdominal wall to gain access into the abdominal cavity.
5. **Newton (Unit)**: force needed to accelerate 1 kilogram of mass at the rate of 1 metre per second squared ($kg.m/s^2$).
6. **Primary Peritonitis**: intra-abdominal bacterial infection without an evident source.
7. **Serum Albumin**: blood protein produced by the liver. It is essential in distribution of body fluids and transportation of other proteins and substances within the blood stream.
8. **Wound Breakdown (dehiscence)**: surgical complication in which a wound ruptures or opens up along surgical suture line.
9. **Wound Infection**: invasion/replication of micro-organisms within the wound area, leading to cell injury and tissue damage. Redness of surrounding skin and abnormal discharge from the wound are the major early signs.
10. **Wound Tensile Strength**: the maximum stress (force) or load that two edges of a wound are capable of sustaining without opening up expressed in a unit of force per unit area (N/m^2).

CHAPTER ONE

1.1 INTRODUCTION

Globally about 50 million people at the moment are living with HIV infection. It is estimated that 60-70% of the infected people reside in Sub-Saharan Africa. Zambia, with its population of 13 Million, has about 1.8 Million infected people, according to the 2010 Government of the Republic of Zambia (GRZ) Health Ministry (2010) report. From the same report, the national incidence is about 1.6% of the adult population with the prevalence of 14%.

Out of the infected population a good number will present with surgical conditions that would require surgical intervention in form of laparotomy i.e. access to the abdominal cavity through a midline surgical incision on the front aspect of the abdomen.

In a study conducted at University Teaching Hospital, Lusaka, HIV positive patients experienced delayed wound healing and prolonged hospital stay especially after abdominal surgery (Mugala 1991).

The rate of surgical wound healing is indirectly determined by measuring the wound strength with the use of a Digital Force Gauge (Birsen 2004). After a period of 10-14 days post operation when stitch sutures are removed wound strength is estimated 4.5N (McLatchie 2007). The following risk factors have been associated with low wound strength at the time of stitch suture removal; immunosuppression, presence of surgical site infection and poor nutrition status (Schwartz 2012).

Delayed wound healing is wound strength of less than 4.5N after 14 days post operation or failure of epithelialization to occur after 14 days; failure of skin cells to cover the incisional wound after 14 days (Morandi 1999).

HIV infection causes immunosuppression by depleting CD4+ T-lymphocytes (Kumar 2007). T-lymphocytes are part of the immune cells that play a major role in wound healing. The GRZ Ministry of Health Guidelines (2010) on HIV/AIDS defines immunosuppression as CD4+ count below 350cells/microL.

Patients with immunosuppression due to low CD4+ count (<350) are susceptible to surgical site infections. Presence of surgical site infections will interfere with the natural process of wound healing. The surgical wound tissue is inflammed due to presence of pathological micro-organisms (Schwartz 2012).

Poor nutritional status in HIV positive patients is attributed to their negative nitrogen balance. The body is generally in hypermetabolic state, high protein demand, trying to fight the HIV infection. Proteins are consumed and patients present with muscle wasting, low serum albumin and anaemia. Proteins are used in

the body as building blocks in tissue repair including wound healing. Hypoproteineamia, low blood proteins, will subsequently reduce wound strength post operatively.

In the United Kingdom, Chelsea and Westminster Hospitals, (Davies 1999) HIV patients are initiated on antiretroviral treatment, ART, the moment they are tested positive regardless of the CD4+ count. Elective surgery, laparotomy, is postponed till the CD4+ count is above 350cells/microL. In an event of emergency surgery, patients receive prophylactic (preventive) intravenous antibiotics post operatively for more than five days instead of a single dose before operation as with those who are negative. Haemoglobin level is kept above 10g/dL by blood transfusion to avoid anaemia.

In South Africa, Johannesburg General Hospital, (Williams 2003) HIV positive patients receive post-operative prophylactic antibiotic for more than five days. In addition if serum albumin is found less than 30g/L they receive albumin supplement. Parenteral nutrition, intravenous feeding, is commenced immediately after surgery. This practice has equally shown to improve wound strength post operatively.

At the University Teaching Hospital, Lusaka, the introduction of Routine Diagnostic, Counseling, Testing and Care (RDCTC) has markedly improved wound healing in HIV positive patients (Odimba 1998). Patients are tested in admission ward and if found positive with a low CD4+ count below 350 are started on treatment. However, this practice does not have immediate positive effect on the wound strength post operatively especially in an emergency set up.

1.2 LITERATURE REVIEW

Acute abdomen in the HIV-infected patient is a common surgical condition which constitutes a complicated diagnostic and therapeutic problem (Christophoros 2011). Surgical conditions which HIV patients may present with in acute abdomen are the following; infectious conditions [acute appendicitis & peritonitis] and non-infectious conditions [intestinal obstruction & gastrointestinal malignancies] (Rafiq 2004). Emergent abdominal operation by itself predisposes the AIDS patient to an increased mortality risk. On the other hand, delayed diagnosis and late surgical exploration result in increased morbidity and mortality. Although profound immunosuppression is associated with poor prognosis, asymptomatic HIV-infected

patients recover well from surgery and do not appear to suffer delayed healing. Yet, with new antiretroviral therapy the operative mortality has dropped as much as necessary for emergency abdominal surgery and the risk-benefit analysis is now more in favour of laparotomy (Christophoros 2011).

Post laparotomy wound repair is a classic example of primary union or healing by first intention (Kumar 2007). This is the healing of a clean, uninfected surgical incision approximated by surgical sutures (Kumar 2007). The stages of normal wound healing process are divided as follows; Day 0-3 haemostasis and inflammatory phase, Day 4-12 proliferative phase and Day 13-⩾90 collagen accumulation and remodeling (Schwartz 2012).

During the phase of haemostasis and inflammation, T-lymphocyte (immune cells) numbers peak at about one week post operation and bridge the transition from the inflammatory to proliferative phase of healing (Witte 1997). In proliferative phase tissue continuity is re-established (Singer 1999).

Collagen is the most abundant protein in the body (Williams 2003). Type I collagen is the major component of extracellular matrix in skin (Werner 2002). Type III collagen, also normally present in skin, becomes more prominent and important during the repair process (Werner 2002).

Glycosaminoglycans comprise a large portion of the “ground substance” that makes up granulation tissue (Rahban 2003). They are rarely found free, they are coupled with proteins to form proteoglycans (Rahban 2003).

Wound strength and mechanical integrity in the fresh wound are determined by both the quantity and quality of the newly deposited collagen (Cross 2003). Although tissue integrity and strength are being re-established, the external barrier must also be re-stored (Cross 2003). Re-epithelialization is complete in less than 48 hours in the case of approximated incised wounds (Singer 1999).

Digital force gauge M3-2 model is designed for tension force testing applications. It has a capacity of 10N, accuracy of +/- 0.3% full-scale +/- 1 digit with a resolution of 0.01N (Electromatic User’s Guide 2014). This gauge is used to measure the wound

strength. Wound strength reaches approximately 31.5 – 36N by 3months but usually does not substantially improve beyond that point (Kumar 2007). When sutures are removed, usually at 10 days, wound strength is approximately 4.5N but increases rapidly over the next 4 weeks (Kumar 2007).

In a systematic comparison study by Van (1975) done on 6 suture materials used for closure of abdominal incisions it was demonstrated that there was no difference in wound strength among wounds closed with different suture materials up to 28 days postoperatively.

Wound strength in normal healing is affected by both systemic and local factors; immunosuppression, poor nutritional status and presence of surgical site infection (Witte 1997).

Anecdotal clinical evidence shows that HIV infection is the commonest cause of immunosuppression in Zambia. The entry of HIV into cells requires the CD4+ molecule which acts as a high affinity receptor for the virus (Kumar 2007). This explains the tropism of the virus for CD4+ T-lymphocytes (Kumar 2007).

The major effect of immunosuppression is inhibition of the inflammatory phase of wound healing thus reduce collagen synthesis and ultimately wound strength (Werner 2002).

Poor nutritional status in malnutrition correlates clinically with enhanced rates of wound complications and increased wound failure following diverse surgical procedures (Cross 2003). Proteins enhance wound healing by promoting wound fibroplasia and wound collagen deposition (Rahban 2003).

Body Mass Index (BMI) was developed based on associations between BMI and chronic disease and mortality risk in healthy populations (Winter 2014). There was convincing evidence that mortality and morbidity risk significantly increased as BMI decreased below 18.5kg/m^2 (Winter 2014).

Low oxygen tension has a deleterious effect on all aspects of wound healing (Williams 2003). Mild to moderate normovoleamic anaemia does not appear to

adversely affect wound oxygen tension and collagen synthesis unless the haemoglobin level falls below 7g/dl (Williams 2003).

Most surgical wound infections become apparent within 7-10 days post operatively (Witte 1997). The host response that helps in diagnosing wound infection comprises cellulitis, abnormal wound discharge, delayed wound healing and increased pain sensation (Cross 2003). The use of prophylactic antibiotics has reduced the incidence of wound infection (Singer 1999).

In a study conducted at University Teaching Hospital, Lusaka, it was shown that the experience of surgeons in Zambia with patients infected with human immunodeficiency virus (HIV) suggested impaired healing of wounds, wound breakdown, and the development of skin lesions and ulcers (Barley 1995)

Mugala (1991) at University Teaching Hospital, Lusaka demonstrated that wound healing in HIV positive patients was delayed, especially those who had abdominal surgery. However, he showed no significant difference in the duration of wound healing with those who had limb surgery. This study also demonstrated that there was no significant difference in duration of wound healing considering that most surgery was done on limbs (P. Value=1).

Odimba (2007) at University Teaching Hospital, Lusaka in a prospective cross sectional study demonstrated that Routine Diagnostic Counseling, Testing and Care (RDCTC) improved the surgical outcome in the sense that patients tested positive and found with a low CD4+ count were initiated on Antiretroviral Treatment (ART). It was further shown that those tested positive and on treatment (ART) improved quicker than the ones tested positive but not on treatment (ART). From the same study, it was recommended that Routine Diagnostic Counseling, Testing and Care (RDCTC) be done in all the surgical units and services. It was also recommended that HIV positive patients with a CD4+ count less than 350 be treated accordingly.

In another study conducted at Robert Wood Johnson Medical School, and Cooper Hospital University Medical Centre, New Jersey, USA on predictors of operative outcome in HIV positive patients it was concluded that the clinical outcome in HIV-

infected and AIDS patients, both immune cell counts and HIV-1 RNA counts were found to associate with postoperative mortality. However, the postoperative decrement in percent CD4+ lymphocyte proved to be independent predictors of postoperative complications (Tran 2000).

In a prospective study at University of Milan, Italy of healing time after hemorrhoidectomy, influence of HIV infection, acquired immunodeficiency syndrome, and anal wound infection, Cox's model revealed that HIV positivity and the presence of acquired immunodeficiency syndrome significantly delayed wound healing, which also correlated with the presence of infection. The healing rate in HIV-positive patients was 66 percent after 14 weeks and 100 percent after 32 weeks; the corresponding figures for patients with acquired immunodeficiency syndrome were 0 and 50 percent. All the controls were healed after 14 weeks. Centres for Disease Control and Prevention HIV- positive status (including CD4+ counts) and the performance status proved to be prognostic value (Morandi 1999).

In a study conducted at St Stephen's Hospital, London showed that postoperative anorectal wounds were found to heal extremely slowly and therefore conservative management was recommended in patients with HIV infection and a CD4+ count of below 200cells/microL (Wakeman 1991).

In another similar study conducted at St Vincent's Hospital, Sydney, Australia, were accurate information about wound healing was available for 74% of first operations, and univariate and multivariate logistic analyses of these showed that when the CD4+ T-lymphocyte count was <50 cells/microL, healing was significantly retarded. The Centres for Disease Control group, patient age, and serum albumin were not significant predictors of wound healing (Lord 1997).

1.3 STATEMENT OF THE PROBLEM

Patients with immunosuppression due to HIV infection who undergo midline laparotomy present with multiple complications. Delayed wound healing and wound breakdown are the commonest.

The table below presents the outcome of 65 operations conducted at UTH in a period of three months on patients who were HIV positive.

Table 1: Abdominal Operations Done at UTH in HIV Patients between Jan-Apr2013

Indication for Operation	**Number of Cases**	**Associated Complications**	**Number of Complicated Cases**	**Percentage**	**Duration of Stitch Sutures (Days)**
Peritonitis (Infectious Causes)	30	Surgical Site Infection with no Wound Breakdown	15	23%	10-14
Abdominal Malignancy	20	Surgical Site Infection with Wound Breakdown	5	7.7%	10-14
Non-malignant Conditions	15	Wound Breakdown with no Apparent Surgical Site Infection	10	15%	10-14

Source: Surgical Audits Jan 2013-Apr 2013

A total number of 65 operations were done in HIV positive patients by all the five General Surgical Firms in the Department of Surgery. Out of the 65 cases 30 (46%)

presented with associated complications; 15 (23%) presented with surgical site infection with no wound breakdown, 5 (7.7%) presented with surgical site infection with wound breakdown and 10 (15%) presented with wound breakdown with no apparent surgical site infection. A number of 15 (23%) cases presented with wound breakdown. Wound breakdown in this case was attributed to low wound strength 14 days after abdominal surgery.

1.4 STUDY JUSTIFICATION

Immunosuppression due to HIV infection is one of the factors which causes delayed wound healing (Davies 1999). However, delayed wound healing has not been clinically defined in terms of duration (Morandi 1999). It is of clinical importance that the period of wound healing be specified in relation to CD4+ count and wound strength as this will assist with clinical judgment in HIV positive patients with a low CD4+ count who need surgical treatment in form of laparotomy. Emergency cases if there is no wound infection post- operatively, stitch sutures can be kept one week longer than the usual duration (10-14 days) to allow holding of the two wound edges and in case of elective surgery but with a low CD4+ count surgery can be postponed and initiate the patient on antiretroviral treatment (ART) if the patient is not yet on ART until the CD4+ count raises to a certain level associated with less postoperative complications.

1.5 RESEARCH QUESTION

Is there a relationship between wound strength and immunosuppression due to low CD4+ count in post laparotomy HIV positive patients?

1.6 NULL HYPOTHESIS

HIV Immunosuppression due to low CD4+ count has no effect on post laparotomy wound strength.

CHAPTER TWO

2.0 OBJECTIVES

2.1 GENERAL OBJECTIVE:

To determine the risk factors associated with post laparotomy wound strength in HIV positive patients.

2.2 SPECIFIC OBJECTIVES:

1. To determine the prevalence of wound breakdown in post midline laparotomy patients with HIV infection.
2. To investigate the relationship between immunosuppression due to low CD4+ count and wound strength in post laparotomy HIV positive patients.
3. To study other risk factors associated with wound strength in wound healing.

CHAPTER THREE

3.1.0 METHODOLOGY

This was a cross-sectional study of the risk factors associated with wound strength in post midline laparotomy HIV positive patients. The study was conducted in surgical wards at the University Teaching Hospital (UTH), Lusaka, Zambia for a period of six (6) months from January 2014 to June. The study population was all HIV positive patients who underwent midline laparotomy.

Sample Size: estimated sample size for a one-sample correlation test (Lachin, J.M. 1981).

- **Fisher's z-test**

H0: r=r0 versus Ha: r! =r0

Study parameters:

- Alpha=0.0500
- Power=0.8000
- Delta=0.2700
- r0=0.4000
- ra=0.6700

Estimated sample size: **N= 56**

The Author applied convenient sampling of all HIV patients post midline laparotomy admitted to the surgical wards who fulfilled the study inclusion criteria. The Principle Investigator, who is the Author, selected all the record files of patients who underwent abdominal surgery. From the record files HIV status was checked since HIV testing was mandatory for all patients who underwent any form of surgical operation.

3.2.0 INCLUSION AND EXCLUSION CRITERIA

3.2.1 INCLUSION CRITERIA

The following was the inclusion criteria:

1. Patients or guardians who consented in writing or right thump-print to participating in the study.
2. All HIV positive patients aged 18 years and above who underwent abdominal surgery.

3.2.2 EXCLUSION CRITERIA

The following types of patients were excluded from the study:

1. Patients who had uncontrolled Diabetes mellitus, TB, Renal Failure, Chronic Liver Disease.
2. All patients who underwent organ transplant on immunosuppressive drugs.

3.3.0 CLINICAL PROCEDURE

Recruitment of patients was done throughout the week in surgical wards at the University Teaching Hospital. The Principle Investigator obtained consent from post midline laparotomy patients or caregivers within ten (10) days post operation. After which the Author obtained History and did a Clinical Examination from participants who fulfilled the inclusion criteria. Blood (6mls) was collected from enrolled patients for baseline CD4+ count, FBC and Serum Albumin. The Author discussed with the admitting Surgical Firm after enrolling the participants to the study. The tensile strength of the wound was then measured on Day 10 before patient discharge by the use of Digital Force Gauge. This is an electronic digital gadget which measures the force between tissues. It has a probe which picks the force between two wound edges. This probe is removable for easy disinfection. It was

immersed in 2% formaldehyde disinfectant solution for 30 minutes before its use on a next patient. The probe was placed between stitches after removing two concurrent stitches. Units of wound strength were displayed on the screen of the Digital Force Gauge. All enrolled patients were kept in the hospital for at least ten (10) days before discharge. All the data and information were recorded on the data collecting sheet (Questionnaire). This took approximately six (6) months as the duration of the study.

3.4.0 VARIABLE DESCRIPTIONS

3.4.1 DEPENDENT VARIABLE

1. Wound strength on Day Ten (10)

3.4.2 INDEPENDENT VARIABLES

1. Immunosuppression due to low CD4+ count.
2. Use of postoperative antibiotics.
3. Presence or absence of wound infection.
4. Poor nutritional status determined by body mass index (BMI) and levels of haemoglobin (HB) and Serum Albumin.
5. Suture material

3.5.0 DATA MANAGEMENT

The author administered the data-collecting tool, questionnaire to review and ensure uniformity see **APPENDIX C.** Results were presented in the tables of baseline characters. Data was summarized as means and standard deviations for continuous variables. Percentages were calculated for categorical variables. A 2x2 table was used to check for association between dependent and independent variables. Coefficient correlation test was also used to establish the association. Linear regression analysis was used to measure the association between CD4+ count and wound strength. Multivariate regression analysis was used to measure the

association between other risk factors and wound strength to rule out confounding factors.

3.6.0 ETHICAL CONSIDERATION

Information regarding the purpose of the study as well as the study procedure was given to patients and /or guardians. The benefits of measuring the wound strength were explained to the patient. Wound strength found to be less than 2.5N stitch sutures were not removed to prevent wound breakdown. This helped to monitor the rate of wound healing in patients who were HIV positive. The risk of cross wound infection should the Digital Force Gauge be improperly used was explained to the patient. Cross wound infection was avoided by disinfecting the gadget thoroughly before its use on each and next patient. Only those who consented to participating to the study in writing (or by thumb print) were recruited.

HIV status and other health problems undisclosed to patients' relatives were kept confidential throughout the study. The HIV status was checked from the patients' record file since Routine Diagnostic Counseling, Testing & Care (RDCTC) had been implemented on all surgical patients. Participation in the study was voluntary and patients or guardians were not coerced to give consent or receive any remuneration (monetary or otherwise) during the study. Recruited patients or their guardians were free to withdraw their participation in the study at any time without compromise to their post-operative care.

All patients' records were kept confidential and only used for research purposes. Access to the information was restricted to the Author and the Supervisor only. Any pertinent information to the patient's well-being was communicated to the attending Surgeons. A patient identity number and not patient's name was entered onto the data extraction sheet.

Ethical approval was sought from the University of Zambia Research Ethics Committee. Permission to utilize the hospital premises was sought from the Medical Superintendent of UTH.

CHAPTER FOUR

4.0 DESCRIPTIVE DATA OF THE PARTICIPANTS

4.1 Overview

This chapter presents the results of the study. The main objective of the study was to determine the risk factors associated with post laparotomy wound strength in HIV positive patients at the Teaching Hospital in Lusaka. The specific objectives of the study were 1) to determine the prevalence of wound breakdown in post midline laparotomy patients with HIV infection, 2) to investigate the relationship between immunosuppression due CD4+ count and wound strength in post laparotomy HIV positive patients, and 3) to study other risk factors associated with wound strength in would healing.

4.2 Demographic Characteristics of the Patients

Table 2: Demographic Characteristics of Patients

Variable	Values	Frequency (n=56)	Percentage	Post Lap CD4+ Count- cells/µL (Range)	Day 10 Wound Strength- N/m2 (Range)
Sex	Male	30	53.6	23-600	0.38-6.33
	Female	26	46.4	36-513	0.48-6.08
Age	18-35	26	46.4	23-418	0.38-6.02
	36-50	18	32.1	36-600	0.49-6.33
	51-65	8	14.3	38-458	0.48-5.91
	>65	4	7.1	74-283	1.08-3.04
Body Mass Index (BMI)	Very Severely Underweight (<15.0)	3	5.4	23-74	0.38-1.08
	Severely Underweight (15.0-16.0)	4	7.1	36-130	0.49-1.79
	Underweight (16.1-18.5)	28	50.0	48-418	0.42-5.49
	Normal (18.6-25.0)	18	32.1	108-458	2.32-6.02
	Overweight (25.1-30.0)	2	3.6	409-513	5.79-6.08
	Obese (>30.0)	1	1.8	600	6.33
Duration of Hospital Stay	10 days	38	67.9	108-600	1.23-6.33
	11-15 Days	7	12.5	96-280	1.20-3.27
	>15 days	11	19.6	23-88	0.38-1.56

Table 2 presents the demographic characteristics of the patients involved in the study. There were fifty-six (56) patients involved in the study; thirty (53.6%) males

with a post laparotomy CD4+ count range of 23- 600 and wound strength ranging from 0.38- 6.33N; and twenty-six (46.4%) females with a CD4+ count range of 36- 513 and wound strength ranging from 0.48 to 6.08N. Twenty-six (46.4%) were aged 18- 35 years, 18 (32.1%) were aged 36- 50 years, 8 (14.3%) were aged 51- 65 years, and 4 (7.1%) were aged over 65 years. The youngest was aged 18 years whilst the oldest was aged 72 years giving an average age of 33.51 years. Twenty-eight (50.0%) patients were underweight with a CD4+ count range of 48- 418 and wound strength ranging from 0.42- 5.49N, 18 (32.1%) had a normal BMI with a CD4+ count range of 108- 458 and wound strength ranging from 2.32- 6.02N, 4 (7.1%) were severely underweight with a CD4+ count range of 36- 130 and wound strength ranging from 0.49- 1.79N, 3 (5.4%) were very severely underweight with a CD4+ count range of 23- 74 and wound strength ranging from 0.38 – 1.08N, 2 (3.6%) were overweight with a CD4+ count range of 409 – 513 and wound strength ranging from 5.79 – 6.08N; and 1 (1.8%) was obese with a CD4+ count of 600 and wound strength of 6.33N. Thirty-eight (67.9%) patients with a CD4+ count range of 108 - 600 and wound strength ranging from 1.23 - 6.33N had stayed in the hospital for ten days, 7 (12.5%) with a CD4+ count range 96- 280 and wound strength from 1.20 - 3.27N had stayed in the hospital for 11 - 15 days; and 11 (19.6%) patients with a CD4+ count range 23 – 88 and wound strength ranging from 0.38 – 1.56N had stayed in the hospital for more than 15days.

4.3 Surgical Conditions Patients Presented With During the Study Period

Table 3: Indications for Abdominal Surgery (Laparotomy) in HIV Patients

Surgical Condition	Frequency	Percent (%)	Post Lap CD4+ Count (Range)	Day 10 Wound Strength (Range)
Primary Peritonitis	15	26.8	96-308	1.20-4.82
Peritonitis Secondary to Perforated Small Bowel	9	16.1	112-409	2.41-5.82
Peritonitis Secondary to Ruptured Appendix	7	12.5	70-310	1.18-5.11
Intestinal Obstruction Secondary to Sigmoid Volvulus	7	12.5	189-600	2.14-6.33
Intestinal Obstruction Secondary to Colorectal Cancer	5	8.9	161-418	2.09-5.49
Intestinal Obstruction Secondary to Adhesions	4	7.1	23-88	0.38-1.56
Obstructive Jaundice Secondary to Cancer of the Head of Pancreas	3	5.4	48-49	0.42-.89
Intestinal Obstruction Secondary to Compound Volvulus	2	3.6	118-280	1.30-3.27
Acute Pancreatitis	2	3.6	110-358	1.92-4.74
Anorectal Cancer	2	3.6	36-74	0.48-1.08
Total	56	100.0	23- 600	0.38-6.33

Table 3 presents the indications for abdominal surgery (Laparotomy) in HIV patients during the study. Fifteen (26.8%) patients had Primary Peritonitis with a CD4+ count range of 96-308 and wound strength ranging from 1.20-4.82N, nine (16.1%) had Peritonitis Secondary to Perforated Small Bowel with a CD4+ count range of 112-409 and wound strength ranging from 2.41-5.82N, seven (12.5%) patients had Peritonitis Secondary to Ruptured Appendix with a CD4+ count range of 70-310 and wound strength ranging from 1.18- 5.11N, seven (12.5%) patients had Intestinal Obstruction Secondary to Sigmoid Volvulus with a CD4+ count range of 189-600 and wound strength ranging from 2.14-6.33N, five (8.9%) patients had Intestinal Obstruction Secondary to Colorectal Cancer with a CD4+ count range of 161- 418 and wound strength ranging from 2.09-5.49N, four (7.1%) patients had Intestinal Obstruction Secondary to Adhesions with a CD4+ count range of 23-88 and wound

strength ranging from 0.38-1.56N, three (5.4%) patients had Obstructive Jaundice Secondary to Cancer of the Head of Pancreas with a CD4+ count range of 48-49 and wound strength ranging from 0.42-0.89N, two (3.6%) patients had Intestinal Obstruction Secondary to Compound Volvulus with CD4+ count range of 118-280 and wound strength ranging from 1.30-3.27N, two (3.6%) patients had Acute Pancreatitis with a CD4+ count range of 110-358 and wound strength ranging from 1.92-4.74N; and two (3.6%) patients had Anorectal Cancer with a CD4+ count range of 36-74 and wound strength ranging from 0.48-1.08N.

Table 4: Performed Surgical Procedure

Surgical Procedure	Frequency	Percent (%)	Post Lap CD4+ Count (Range)	Day 10 Wound Strength (Range)
Laparotomy + Peritoneal Lavage	15	26.8	96-308	1.20-4.82
Laparotomy, Bowel Resection + Bowel Anastomosis + Lavage	9	16.1	112-409	2.41-5.82
Laparotomy, Appendicectomy + Lavage	7	12.5	70-310	1.18-5.11
Laparotomy, Sigmoidectomy +Bowel Anastomosis	7	12.5	189-600	2.14-6.33
Laparotomy, Tumour Resection + Colostomy	5	8.9	161-418	2.09-5.49
Laparotomy + Adhesiolysis	4	7.1	23-88	0.38-1.56
Laparotomy + By-pass	3	5.4	48-49	0.42-.89
Laparotomy, Bowel Resection + Bowel Anastomosis	2	3.6	118-280	1.30-3.27
Laparotomy + Peritoneal Lavage	2	3.6	110-358	1.92-4.74
Laparotomy + Abdomino-Perineal Resection (APR)	2	3.6	36-74	0.48-1.08
Total	56	100.0	23-600	0.38-6.33

The following surgical procedures were performed in patients with indications for abdominal surgery, refer to Table 3: fifteen (26.8%) Laparotomy + Peritoneal Lavage, nine (16.1%) Laparotomy, Bowel Resection, Bowel Anastomosis + Peritoneal Lavage, seven (12.5%) Laparotomy, Appendicectomy + Peritoneal Lavage, seven (12.5%) Laparotomy, Sigmoidectomy + Bowel Anastomosis, five (8.9%) Laparotomy, Tumour Resection + Colostomy, four (7.1%) Laparotomy + Adhesiolysis, three (5.4%)

Laparotomy + By-pass, two (3.6%) Laparotomy, Bowel Resection + Bowel Anastomosis, two (3.6%) Laparotomy + Peritoneal Lavage; and two (3.6%) Laparotomy + Abdomino-Perineal Resection (APR) see **Table 4**.

Table 5: Experience of Surgeon

Surgeon	Frequency	Percent	Post Lap CD4+ Count (Range)	Day 10 Wound Strength (Range)
Registrar	32	57.1	23-600	1.20-5.79
Senior House Office	14	25.0	96-409	0.38-6.33
Senior Registrar	6	10.7	36-360	0.48-6.02
Consultant	4	7.1	48-82	0.42-1.56
Total	56	100.0	23-600	0.38-6.33

The study had further revealed that 32 (57.1%) patients with a CD4+ count range of 23-600 and wound strength ranging from 1.20-5.79N were operated upon by a Registrar, 14 (25.0%) patients with a CD4+ count range of 96-409 and wound strength ranging from 0.38-6.33N were operated upon by a Senior House Officer, 6 (10.7%) patients with a CD4+ count range of 36-360 and wound strength ranging from 0.48-6.02N were operated upon by a Senior Registrar; and four (7.1%) patients with a CD4+ count range of 48-82 and wound strength ranging from 0.42-1.56N were operated upon by a Consultant (Table 5).

4.4 Past Medical History of HIV Patients

Table 6: Past Medical History of HIV Patients

Variable	Values	Frequency (n=56)	Percentage	Post Lap CD4+ Count (Range)	Day 10 Wound Strength (Range)
Whether patient is on HAART	Yes	41	73.2	36-600	0.49-6.33
	No	15	26.8	23-283	0.38-3.20
Duration of HAART	0-½ years	15	26.8	23-283	0.38-3.20
	½-1 years	16	28.6	36-600	0.49-6.33
	1-3 years	11	19.6	52-513	0.54-6.08
	>3 years	14	25.0	74-409	1.08-5.74
Whether on Immunosuppressive Drugs	Yes	2	3.6	48-108	0.42-2.32
	No	54	96.4	23-600	0.38-6.33
Presence of Pre-Existing Medical Conditions	No/Nil	46	82.1	70-600	1.18-6.33
	Advanced Malignancy	10	17.9	23-88	0.38-1.56

Table 6 presents findings regarding past medical history of HIV patients. Forty-one (73.2%) patients were on HAART with a CD4+ count range of 36-600 and wound strength ranging 0.49-6.33N. Fifteen (26.8%) patients were on HAART for less than half a year, 16 (28.6%) patients were on HAART for ½ to 1 year, 11 (19.6%) patients were on HAART for 1 to 3 years, and 14 (25.0%) patients were on HAART for more than three years. Fifteen (26.8%) patients were not on HAART with a CD4+ count range of 23- 283 and wound strength ranging 0.38- 3.20N. Further analysis showed that only two (3.6%) patients were on immunosuppressive drugs (chemotherapy) with a CD4+ count range of 48-108 and wound strength ranging 0.42-2.32N. Furthermore, forty-six (82.1%) patients had no pre-existing medical conditions while ten (17.9%) had advanced malignancy. Patients with advanced malignancy had a CD4+ count of 23-88 and wound strength ranging 0.38-1.56N. All of the 56 patients received post-operative antibiotics a combination of either (Cephalosporin & Metronidazole) or (Penicillin, Aminoglycoside & Metronidazole).

4.5 Post-Operative Investigations

Table 7: Summary Descriptive Statistics of Post-operative Investigations

	N	Minimum	Maximum	Mean	Std. Deviation
Current CD4 count	56	23.00	600.00	217.2679	131.57431
FBC (HB)	56	5.40	14.20	9.1286	2.14525
Serum albumin	56	13.00	49.00	29.1982	8.67629

Table 7 presents a summary of the post-operative investigations regarding patients' CD4+ Count, FBC and Serum albumin. Patients' CD4+ count ranged from 23 to 600 with a mean CD4+ count of 217.2679 (SD=131.57431). Patients' FBC (HB) ranged from 5.4 to 14.2 with a mean of 9.1286 (SD=2.14525). Patients' serum albumin ranged from 13.0 to 49.0 with a mean of 29.1982 (SD=8.67629).

4.6 Wound Tensile Strength

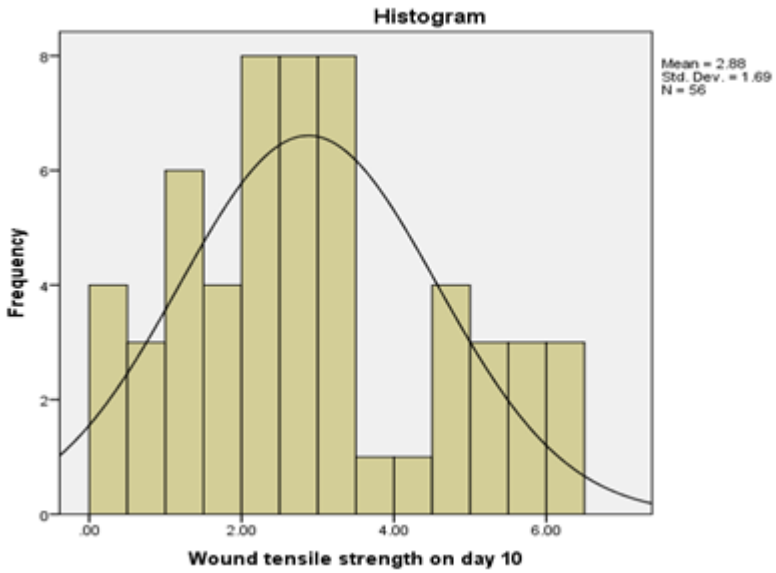

Figure 1: Wound Tensile Strength

Figure 1 shows the distribution of wound tensile strength of the patients ten days after the surgical operation. The wound tensile strength ranged from 0.38 to 6.33.

The mean wound tensile strength was 2.88 (Standard deviation=1.69030), the mode was 2.89.

4.7 Presence of Post-operative Surgical Complications

Table 8: Post-operative Surgical Complications

	Frequency	Percent	Post Lap CD4+ Count (Range)	Day 10 Wound Strength (Range)
Nil	45	80.4	74-600	1.08-6.33
Wound discharge (Surgical Site Infection)	8	14.3	48-170	0.42-1.87
Wound dehiscence	3	5.4	23-38	0.38-0.49
Total	56	100.0	23-600	0.38-6.33

Table 8 above shows that 11 patients had post-operative surgical complications; 8 (14.3%) had a wound discharge, clinical surgical site infection with a CD4+ count range of 48-170 and wound strength ranging 0.42- 1.87N while three (5.4%) had a wound dehiscence with a CD4+ count range of 23-38 and wound strength ranging 0.38-0.49N. Forty-five (80.4%) patients had no post-operative surgical complications and they had a CD4+ count range of 74-600 and wound strength ranging 1.08-6.33N.

ANALYTICAL DATA OF RISK FACTORS ASSOCIATED WITH WOUND STRENGTH

4.8 Risk Factors Associated With Wound Strength in Wound Healing

The study sought to establish risk factors associated with wound strength in wound healing.

First of all, the study further sought to test a null hypothesis that there was no association between immunosuppression due to low CD4+ counts and post laparotomy wound strength. To test this null hypothesis, a correlation coefficient test was conducted at significant level of 0.01. The results showed that there was a significant positive association between immunosuppression due to low CD4+ counts and post laparotomy wound strength (rho=0.944 (n=56); p=0.001). These results are confirmed in Figure 2 below which reveals that wound tensile strength increases with increasing CD4+ count.

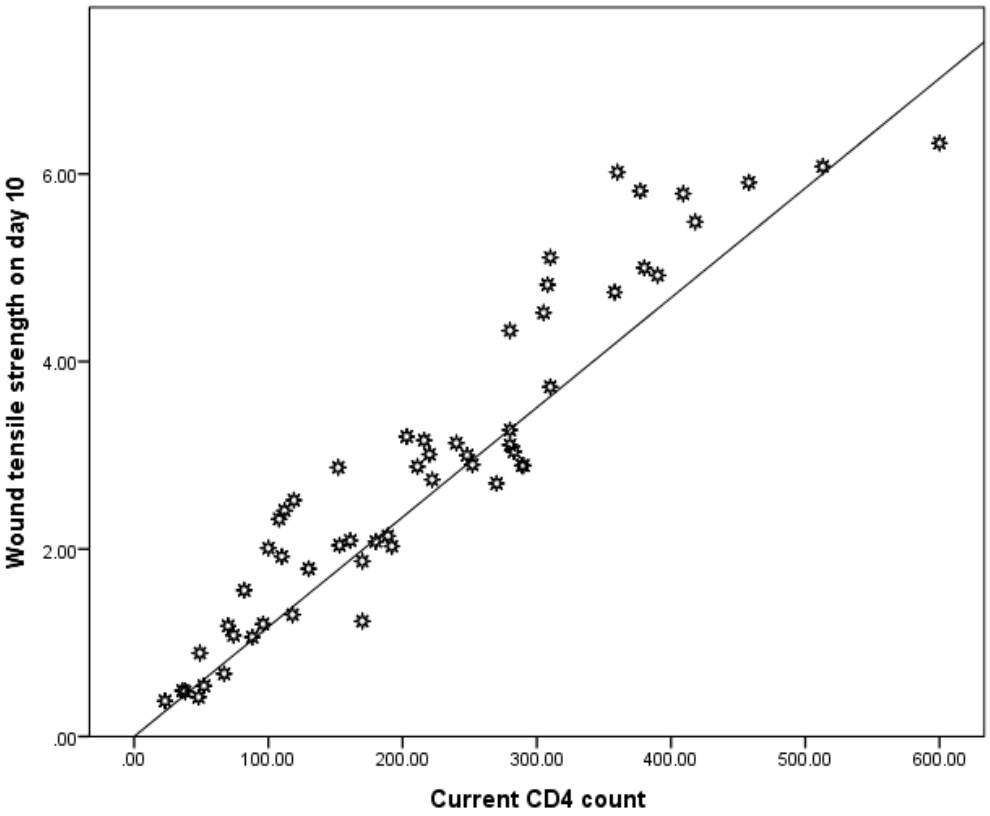

Figure 1: Correlation between CD4+ Count and Wound Tensile Strength

Secondly, the study further sought to establish whether there was an association between Haemoglobin (HB) and post laparotomy wound strength. Figure 3 below reveals that there was a positive association between wound tensile strength and HB. Wound tensile strength increases with increasing HB. These results were further confirmed by a correlation coefficient test whose results revealed a significant positive association between HB and post laparotomy wound strength (rho=0.811 (n=56); p=0.001).

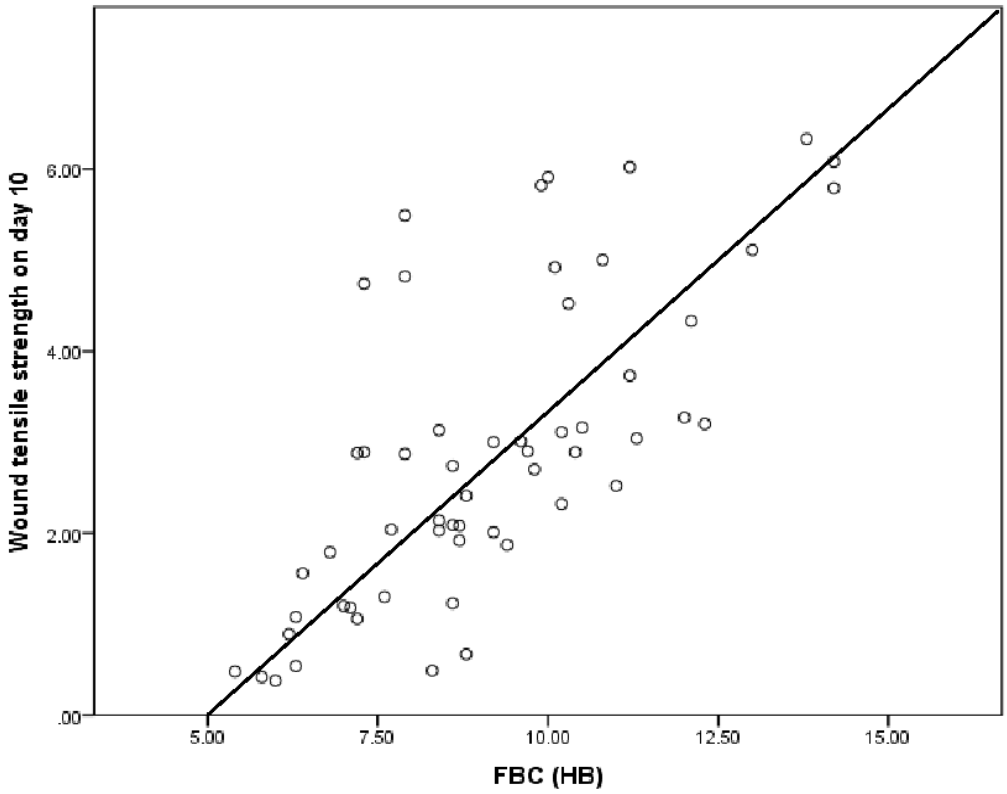

Figure 2: Correlation between FBC (HB) and Wound Tensile Strength

Thirdly, the study further sought establishes whether there was an association between serum albumin and post laparotomy wound strength. Figure 4 below reveals that there was a positive association between wound tensile strength and serum albumin. Wound tensile strength increases with increasing serum albumin. These results were further confirmed by a correlation coefficient test whose results revealed a significant positive association between serum albumin and post laparotomy wound strength (rho=0.711 (n=56); p=0.001).

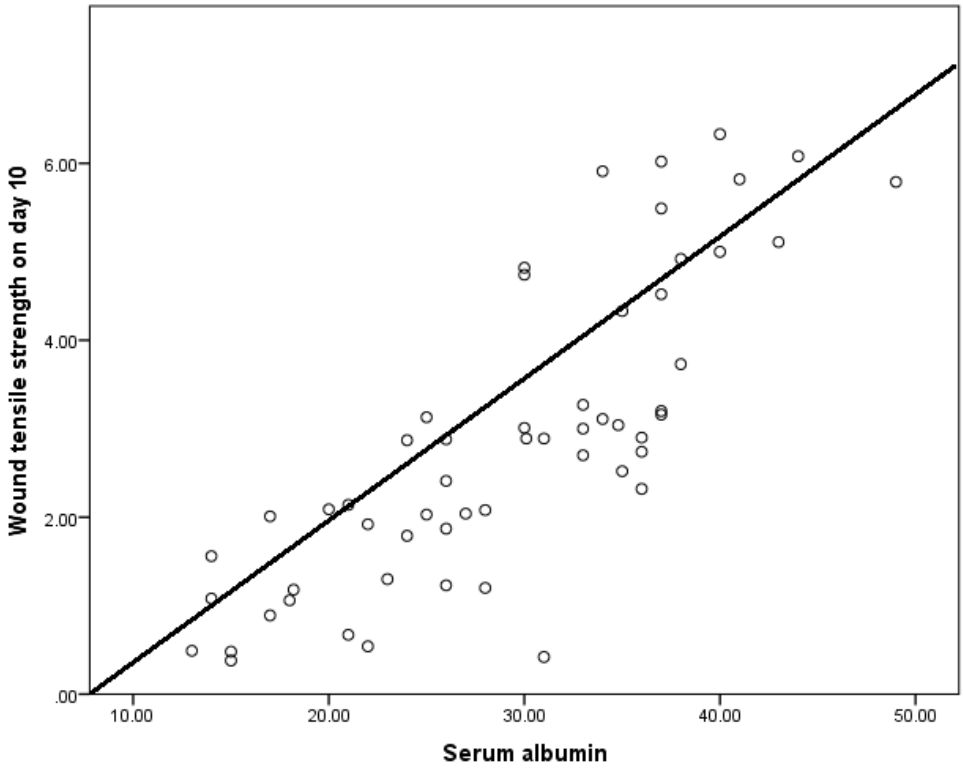

Figure 3: Correlation between Serum Albumin and Wound Tensile Strength

Multiple linear regression analysis was used to develop a model for predicting post laparotomy wound strength. Basic descriptive statistics and regression coefficients are shown in Table 9. The results show that each of the predictor variables has a significant ($p < .01$) zero-order correlation with post laparotomy wound strength, but only CD4+ count and Serum albumin predictors had significant ($p < .01$) partial effects in the full model. The three predictor model was able to account for 90.1% of the variance in post laparotomy wound strength, F (3, 52) = 157.398, $p < .001$, R^2 = .901, 95% CI [-1.157, .300]. The results show that CD4+ count is the best predictor of post laparotomy wound strength followed by serum albumin.

Table 9: Summary of Regression Analysis Results

	Zero-Order *r*				β	sr^2	*B*
Variable	SA	FBC (HB)	CD4	WTS			
CD4				944*	.010*	.001	.806
FBC (HB)			.701*	.711*	.026	.057	.033
SA		.789*	.796*	.811*	.028	.017	.144
					Intercept = -.429		
Mean	29.10	9.13	217.27	2.88			
SD	8.68	2.15	131.57	1.69	R^2 =.901*		

Key: SA=Serum Albumin; FBC (HB) = Full Blood Count (Hemoglobin); WTS=Wound Tensile Strength; CD4= CD4+ count

*p < .01

CHAPTER FIVE

5.0 DISCUSSION

This study has demonstrated that the majority of HIV patients who underwent abdominal surgery were male (30) with a percentage of 53.6%. The age range of both male and female which made the majority (26) was from 18 years of age to 35. These findings are in conformity with the national epidemiology of the disease burden as shown in the Government of the Republic of Zambia (GRZ) Health Ministry (2010) Report.

Patients with advanced HIV Disease were in negative nitrogen balance signifying weight loss (Schwartz 2012). In this study out of 56 patients, 35 had Body Mass Index (BMI) that of below normal value of 18.5. See Appendix E

5.1 Surgical Conditions of Patients during the Study Period

In a study conducted at University Teaching Hospital it was shown that surgical conditions which required laparotomy were divided into infective conditions leading to peritonitis and non-infective conditions mainly malignancies (Barley 1995). This study showed that 31 patients presented with peritonitis, 10 presented with abdominal malignancies and 15 presented with surgical conditions not associated with HIV Disease. All these patients underwent abdominal surgery in a form of midline laparotomy. Abdominal surgery was performed by Senior House Officer, Registrar, Senior Registrar and Consultant. The outcome of surgery was almost the same throughout the study. This showed that experience of the operating surgeon did not have a direct bearing on the outcome of surgery.

5.2 Past Medical History of Patients

In this study 41 patients were on treatment for HIV Disease and 15 were not. Ten (10) of the patients had abdominal malignancy. At the University Teaching Hospital (Odimba 1998) it was demonstrated that Diagnostic, Counseling, Testing and Care (DCTC) had markedly improved wound healing in HIV positive patients. Patients were tested in admission ward and if found positive with a low CD4+ count below 350 were started on treatment. The practice did not have immediate positive effect

on wound strength post operatively especially in an emergency setup. This is due to the fact that it took a long period of time for the CD4+ count to increase to significant levels once initiated on treatment after surgery.

5.3 Post-operative Investigations

The following investigations were done on all enrolled patients in relation to the associated risk factors; CD4+ count to investigate HIV immunosuppression, full blood count (FBC) to determine the levels of Haemoglobin and Serum albumin to investigate the levels of protein in blood. FBC and HB were used to determine the nutritional status of the patients. In this study patients' CD4+ count ranged from 23 to 600 with a mean CD4+ count of 217.2679 (SD=131,57431). Full blood count results showed that Haemoglobin (HB) ranged from 5.4g/dl to 14.2g/dl with a mean of 9.1286 (SD=2.14525). Serum albumin ranged from 13.0 to 49.0g/L with a mean of 29.1982. Severe immunosuppression in this study was considered to be CD4+ count of 200 and below. In severe immunosuppression wound strength was markedly reduced below 4.5N. The mean haemoglobin (HB) level was 9.12g/dl. HB below 7.0g/dl had a negative effect on wound strength. Mean serum albumin was 29g/L. Severe hypoalbuminaemia in this study was below 20g/L. With serum albumin of below 20g/L there was an associated decrease in wound strength.

5.4 Wound Tensile Strength

When stitch sutures were removed, usually at 10 days, wound strength was approximately 4.5N but increased rapidly over the next four (4) weeks (Kumar 2007). Wound strength in this research ranged from 0.38N to 6.33N with a mean of 2.88N (SD=1.69030) and the mode was 2.89N. It was demonstrated that more than half of the patients had wound strength of below 4.5N on day 10 after abdominal surgery.

5.5 Risk Factors Associated with Wound Strength

Wound strength in normal healing was affected by both systemic and local factors; immunosuppression, poor nutritional status (haemoglobin and serum albumin) and presence of surgical site infection (Witte 1997). The study sought to test a null

hypothesis that there was no association between immunosuppression due to low CD4+ count and post laparotomy wound strength. A correlation coefficient test was conducted at significant level of 0.01. The results showed that there was a significant positive association between CD4+ count and wound strength (rho=0.944, (n=56); p=0.001). See Figure 2 which revealed that wound strength increased with increasing CD4+ count. In a study conducted at St Stephen's Hospital, London showed that post-operative abdominal surgical wounds healed extremely slowly in patients with a CD4+ count of below 200cells/microL (Wakeman 1991). The findings in the above study are in with the results of this research.

The study further sought to establish whether there was an association between Haemoglobin (HB) and post laparotomy wound strength. Figure 3 confirmed that there was a positive association between wound strength and Haemoglobin. Wound strength increased with increasing HB. The results were further confirmed by a correlation coefficient test whose results revealed a significant positive association between HB and post laparotomy wound strength (rho= 0.811, (n=56); p=0.001). Low oxygen tension had a deleterious effect on all aspects of wound healing (Williams 2003). Mild to moderate normovoleamic anaemia did not appear to adversely affect wound oxygen tension and collagen synthesis unless Haemoglobin fell below 7.0g/dl (Williams 2003).

Furthermore, it was established that there was an association between serum albumin and post laparotomy wound strength. See Figure 4 which revealed that there was a positive association between wound strength and serum albumin. Wound strength increased with increasing serum albumin. The results were further confirmed by a correlation coefficient test whose results revealed a significant positive association between serum albumin and post laparotomy wound strength (rho=0.711 (n=56); p=0.001). Contrary to the above findings, the Centres for Disease Control showed in a study that patient age and serum albumin were not significant predictors of wound healing (Lord 1997).

Multiple linear regression analysis was used to develop a model for predicting post laparotomy wound strength. See Table 9 for basic descriptive statistics and

regression coefficients. The results showed that each of the predictor variables had a significant ($p<0.01$) zero-order correlation with post laparotomy wound strength, but only CD4+ count and serum albumin had significant ($p<0.01$) partial effects in the full model. The three predictor model was able to account for 90.1% of variance in post laparotomy wound strength, $F (3, 52) =157.398$, $p<0.001$, $R^2=0.901$, 95% CI [-1.157, 0.300]. The results showed that CD4+ count was the best predictor of post laparotomy wound strength followed by serum albumin. The above findings were in agreement with that of a study conducted at Robert Wood Johnson Medical School, and Cooper Hospital University Medical Centre, New Jersey, USA.

5.6 Presence of Post-operative Surgical Complications

Refer to Table 8 which shows that 11 patients developed post-operative surgical complications; 8 patients had wound discharge (surgical site infection) and 3 had wound breakdown with a prevalence of 5.4%. Patients who presented with wound secondary to surgical site infection had wound strength in the range of 2.0 – 3.5N whilst those with wound breakdown had wound strength of utmost 1.5N. All of the 56 patients received post-operative antibiotics a combination of either (Cephalosporin & Metronidazole) or (Penicillin, Aminoglycoside & Metronidazole). This combination of antibiotics covered for Gram positives, Gram negatives and anaerobic micro-organisms respectively. Most surgical wound infections became apparent within 7-10 days post-operatively (Witte 1997). The host response that helped in diagnosing wound infection comprised cellulitis, abnormal wound discharge, delayed wound healing and increased pain sensation (Cross 2003). The use of prophylactic antibiotics had reduced the incidence of wound infection (Singer 1999). Mugala (1991) at the University Teaching Hospital, Lusaka demonstrated that wound healing in HIV positive patients was delayed especially those who had abdominal surgery. In this study it was shown that 11 (19.6%) overstayed in the hospital for over 15 days mainly due to delayed wound healing.

CHAPTER SIX

6.1 CONCLUSION

1. Of all the above risk factors associated with wound strength CD4+ count was the best predictor followed by Serum albumin and Haemoglobin (HB) was the least.
2. Wound breakdown could be prevented in HIV positive patients with a CD4+ count 200 and below by keeping stitch sutures longer than 14 days in absence of surgical site infections.
3. Wound breakdown occurred in patients who had wound strength of less than 1.5N. The prevalence 3 out of 56 (5.4%).

6.2 LIMITATIONS

The following were the study limitations:

1. The Force Digital Gauge used in this study to measure the wound strength was very sensitive to subtle movements to the extent that patients' respiratory movements were recorded. This minimally affected the recorded apparent wound strength.
2. It was practically impossible to determine subclinical wound infection in these patients post-operatively since wound swabs were not taken. Throughout the study period determination of wound infection relied on clinical judgment.

6.3 RECOMMENDATIONS

Factors associated with wound strength in HIV positive patients who undergo abdominal surgery have been highlighted in this study. Investigating all post laparotomy patients in relation to the above studied risk factors will help with patient care and reduce on post-operation morbidity.

1. Post-operation CD4+ count must be checked on all HIV positive patients.
2. The Department of Surgery at University Teaching Hospital (UTH) must include in the management protocol that post-laparotomy HIV patients with CD4+ count of below 200 should have their stitch sutures kept longer than 14 days.

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APPENDIX A

Participant Information Sheet

Title: Risk Factors Associated with Wound Strength in Post Midline Laparotomy HIV Positive Patients at the University Teaching Hospital, Lusaka.

I, Dr Chiwele Mutuna from the Department of Surgery in the School of Medicine at the University of Zambia am carrying out a study on abdominal surgical wound healing in patients with HIV infection. This study will be conducted at the University Teaching Hospital, Lusaka, Zambia.

Purpose and Method of the Study

The purpose of this study is to establish the risk factors affecting wound healing in HIV positive patients who undergo abdominal surgery. The risk factors being considered in this study are immunosuppression (low immunity) due to low CD4+ count, poor nutritional status (presence of anaemia and reduced protein in blood) and lastly presence of wound infection. The measurement of wound strength on day ten (10) in this study will help to monitor the rate of wound healing.

Participants will be selected by checking through the files of all those who underwent abdominal surgery in all the surgical wards. HIV testing is compulsory for all patients going to theatre for any form of surgical operation. All those found HIV positive and aged eighteen (18) and above will be selected for enrollment.

Procedures

The study will involve answering basic demographic questions, specific questions as with regard to the surgical condition leading to the abdominal operation, past medical history in particular HIV infection and further investigations to be conducted. Blood (6mls) will be collected by the qualified Principal Investigator. A 10mls syringe with a needle will be used. Collection will be done from one single prick from your vein in the arm to avoid multiple pricks inflicting pain on you. This 6mls of blood will be used for investigating

immunosuppression (low immunity) by checking CD4+level, poor nutritional status by looking for anaemia (reduced haemoglobin) and low protein in blood. Three (3) blood sample bottles, two (2) purple topped and one (1) red topped will be used for storing and transporting blood to the laboratory. 2mls of blood will be put in each sample bottle. Extra care will be taken to prevent accidental needle prick injuries both on collecting and disposing of needles. Used needles will strictly be disposed of in sharp boxes (safety boxes). All participants will not be required to pay for the above investigations. Wound strength will be measured on day ten (10) after operation. Normally all patients who undergo abdominal surgery are discharged from the hospital ward at least seven (7) days after operation to allow enough time to monitor for associated complications and receive adequate treatment. You will stay in the hospital for at least ten (10) days. A Force Digital Gauge shown below will be used to measure wound strength.

Picture1: Force Digital Gauge

This transducer has a removable probe that allows adequate and effective disinfection. Disinfection of the transducer prevents cross wound infection from one participant to the next. No pain will be encountered during wound strength measurement. If wound strength is 10% or more then stitch sutures will be removed and participant will be discharged home. However, if found less than 10% stitch sutures will be kept for three (3) weeks and be removed by the admitting firm in the out-patient clinic during routine post operation reviews.

This study will not interfere in any way with the treatment guidelines of the admitting firm.

Potential Risks

There are no foreseeable risks attributable to participating in this study. Nevertheless, if the probe of the transducer is not adequately disinfected there is a minimal risk of cross wound infection from one participant to the other.

Potential Benefits

The benefits of participating in this study are many. You will make a major contribution to the information known about wound healing in HIV. In the future others may benefit because doctors and surgeons will learn about how low CD4 count in HIV affects wound healing and will come up with a better way of post operation wound care. Early detection of poor wound healing after abdominal operation. If wound strength on day ten (10) is less than 10% stitches will be kept for three (3) weeks and be removed in out-patient clinic by the admitting firm. This delayed stitch removal in this case prevents wound breakdown. From the blood investigations if participant is found with anaemia, blood boosters will be prescribed. A CD4+ count found below 350 and not yet on ART participant will be referred to HIV/AIDS Adult Centre of Excellency for commencement of treatment.

Rights as a Research Participant

Your participation in this study is entirely voluntary. You may decide to withdraw from the study at any time. Such a decision will not affect patient care and treatment. You are free not to answer questions which you may deem personal or otherwise.

Confidentiality

A unique identifier only known to the study personnel will be used instead of your name. Personal information about you will not be released to anyone and will not be used in any publication from this study.

Remuneration

There will be no payment for your participation in this study.

Further Information

If you have any questions or concerns regarding ethical issues in the conducting of this study, you may contact me Dr Chiwele Mutuna on mobile number 0977 636840, Department of Surgery, University Teaching Hospital, P/B RW 1X, Lusaka.

You may also contact the Chairperson of the University of Zambia Biomedical and Research Ethics Committee, Ridgeway Campus, P.O. Box 50110, Lusaka, Zambia, telephone 0211-256067.

APPENDIX B

Informed Consent Form

Title: Risk Factors Associated with Wound Strength in Post Midline Laparotomy HIV Positive Patients at the University Teaching Hospital, Lusaka.

The purpose of this study has been explained to me and I understand the purpose of the study. I further understand that:

If I agree to take part in this study I can withdraw at any time without having to give an explanation and that taking part in this study is purely voluntary.

I…… (NAMES).
Agree to take part in both the interview and in the study.

Signed/Thumbprint……Date…….. (Participant)

Signed……Date…….. (Researcher)

NB: The participant is free not to answer questions he/she may deem personal or otherwise.

APPENDIX C

Data Capture Tool

Title: Risk Factors Associated with Wound Strength in Post Midline Laparotomy HIV Positive Patients at the University Teaching Hospital, Lusaka.

A. Constitutional Information

A1. Sex: 1. M
2. F

A2. Age: 1. 18- 35yrs
2. 36- 50yrs
3. 51- 65yrs
4. >65yrs

A3. Body Mass Index (BMI):

1. Very severely underweight < 15
2. Severely underweight 15.0- 16.0
3. Underweight 16.0- 18.5
4. Normal 18.5- 25
5. Overweight 25- 30
6. Obese >30

B. Current Surgical Condition

B1. Surgical condition:

1. Primary peritonitis
2. Peritonitis secondary to ruptured appendix
3. Peritonitis secondary to perforated small bowel
4. Intestinal obstruction secondary to sigmoid volvulus
5. Intestinal obstruction secondary to compound volvulus
6. Intestinal obstruction secondary to colorectal tumour
7. Anorectal tumour

8. Intestinal obstruction secondary to adhesions
9. Acute pancreatitis
10. Obstructive jaundice secondary to cancer of the head of pancreas

B2. Performed surgical procedure:

1. Laparotomy + peritoneal lavage
2. Laparotomy, appendicectomy + peritoneal lavage
3. Laparotomy, bowel resection + primary anastomosis + peritoneal lavage
4. Laparotomy, sigmoidectomy + primary anastomosis
5. Laparotomy, bowel resection + primary anastomosis
6. Laparotomy, tumour resection + colostomy
7. Laparotomy + abdomino-perineal resection (APR)
8. Laparotomy + Adhesiolysis
9. Laparotomy + peritoneal lavage
10. Laparotomy + by-pass

B3. Administration of post-operative antibiotics:

1. Yes
2. No

B4. Experience of Surgeon:

1. Senior House Office
2. Registrar
3. Senior Registrar
4. Consultant

C. Past Medical History

C1. Whether patient is on treatment (HAART):

1. Yes
2. No

C2. Duration on HAART:

1. 0- ½yr

2. ½- 1yr

3. 1- 3yrs

4. > 3yrs

C3. Whether on immunosuppressive drugs:

1. Yes
2. No

C4. Presence of pre-existing medical conditions such as:

1. No/ Nil
2. Chronic Renal Failure
3. Chronic Liver Disease
4. Advanced Malignancy
5. Diabetes mellitus

D. Post-operative Investigations:

D1. Current CD4 Count….

D2. FBC (HB)….

D3. Serum Albumin….

E. Wound Tensile Strength on:

E1. Day 10….

F. Presence of post-operative surgical complications:

1. Nil
2. Wound discharge
3. Wound breakdown

G. Duration of hospital stay:

1. 10 days
2. 11- 15days
3. >15 days

APPENDIX D

STEPS TAKEN WHEN MEASURING WOUND STRENGTH USING A FORCE DIGITAL GAUGE

i. Procedure explained to the patient.

ii. Patient to lie flat on bed with curtains drawn to ensure privacy.

iii. Abdominal wound exposed and cleaned with methylated spirit swabs.

iv. Newly disinfected probe with Cidex fixed to the Force Digital Gauge.

v. Probe placed between stitches of the wound.

vi. "On" button switched on and readings displayed on the Force Digital Gauge screen.

vii. Readings recorded on data collection sheet.

viii. Patient thanked and dressed.

APPENDIX E

Classification of Adult Underweight, Overweight & Obesity According to BMI (Winter 2014)

Classification	BMI (Kg/m^2)	Chronic Disease Risk
Underweight	<18.5	Low (but increased mortality & morbidity from other causes)
Severe	<16.0	
Moderate	16.0- 16.9	
Mild	17.0- 18.5	
Normal Range	18.5- 24.9	Average
Overweight	≥25.0	
Pre-Obese	25.0- 29.9	Increased
Obese	≥30.0	
Obese class I	30.0- 34.9	Moderate
Obese class II	35.0- 44.9	Severe
Obese class III	≥40	Very Severe