TITLE

LAPAROTOMY WOUND DEHISCENCE AT KENYATTA NATIONAL HOSPITAL.
(1996-2001)

BY

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DECLARATION

THIS DISSERTATION IS MY ORIGINAL WORK AND HAS NOT BEEN PRESENTED FOR A DEGREE COURSE IN ANOTHER UNIVERSITY.

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SUMMARY

This is a retrospective study carried out in Kenyatta National Hospital over a 5-year period from June 1996 to May 2001. The broad objective is to determine the magnitude of laparotomy wound dehiscence and determine the causes and outcome following its management. In this period, 2008 laparotomies were done of which 92 had wound disruption. Due to inadequate data 6 were excluded from this study. Thus only 86 (4.3%) were studied.

The mortality rate was 2.3 % (2/86) while case mortality for primary laparotomy was 10.5 % (211/2008).

The mean age of the patients was 32 years with age range of 11 to 75 years. The male to female ratio was 1:4 (16:70).

Emergency laparotomies accounted for 83% of the cases while 17% were elective procedures.

Abdominal pain, fever, vomiting, coughing and weight loss were the main initial complaints while abdominal tenderness and distension, dehydration and raised temperature were the main physical finding. Anaemia was the main laboratory finding while Human Immunodeficiency Virus (HIV) infection evaluation was inconsistent and thus irrelevant in this study.

Pelvic surgery had the highest incidence of wound disruption (81%) followed by gastrointestinal surgery (15%).

Patients who had vertical incisions were 79, while 7 had transverse incisions.

Layered closure was the preferred mode of stitching with catgut being the suture used to close rectus sheath in 71% of the cases (vicryl was used in 23% and nylon in 6% of the cases).

Most wounds dehiscence occurred between sixth to tenth day (55%) and only 7% dehisced after fifteenth day.
Infection/peritonitis (40%) and damaged sutures (29%) were the implicated leading causes of wound disruption. In relaparotomy mass closure was the preferred method with or without tension sutures (using nylon No. 1 sutures). The average hospitalisation time was 25 days with a range of 6-153 days. Two patients died; a diabetic female patient whose postoperative haemoglobin was 3.8g/dl and a male patient with spontaneous colonic perforation and had HIV infection.
INTRODUCTION
Laparotomy wound dehiscence (LWD) is a term used to describe separation of the layers of a laparotomy wound before complete healing has taken place. Other terms used interchangeably are acute laparotomy wound failure and burst abdomen.

Acute wound failure may be occult or overt, partial or complete. Overt wound failure follows early removal of sutures leading to evisceration. Occult dehiscence occurs with disruption of musculo-aponeurotic layer beneath intact skin sutures.

Wound dehiscence has been noted to occur when a wound fails to gain sufficient strength to withstand stresses placed upon it. The separation may occur when overwhelming forces break sutures, when absorbable sutures dissolve too quickly or when tight sutures cut through tissues.

LWD has remained a puzzle that hasn’t been solved by any surgical unit (i.e. no unit has reported 0% failure rate). However most hospitals globally have achieved and maintained failure rates well below 1%. This however has not deterred continuing research in attempts to eliminate the problem. A number of papers have been published in the past five years trying to explain how this problem can be overcome.

Simek and Danek describe a technique of their own which they have developed in the last ten years and are currently using to prevent wound dehiscence. This technique involves the use of intraperitoneal resorbable mesh in prevention of postoperative wound dehiscence for any patient they consider at risk.
Gislason H. et al\textsuperscript{3} working in Norway and Fleischer G M et al\textsuperscript{4} in Germany independently published results of long term complications of burst abdomen following layered or mass closure of Laparotomy wounds.

In 1998, Graham DJ et al in U.S.A demonstrated that intrabdominal infections increased wound dehiscence significantly\textsuperscript{5}.

In the same year Soran A. et al, working in Japan outlined predictable risk factors as relates to burst abdomen and they recommended certain surgical measures. These measures included control of nausea and vomiting, decompression of distended abdomen, choice of appropriate sutures, control of infection and use abdominal drains. In this study surgeon’s experience and use of more than two abdominal drains were factors significantly associated with wound dehiscence\textsuperscript{6}. 
LITERATURE REVIEW

Historical background

Owing to the fact that not many surgeons would want to have their failures published, literature on wound failure in the past is limited. However, literature on how to prevent wound failure is readily available.

Homer (1050 BC), a great Greek poet, in appreciation of technical ability to treat wounds wrote; “a wise physician skilled our wounds to heal is more than armies for the common weal” (welfare of a country). Today surgeons rely on healing ability, surgical precision and gentleness to tissues to consolidate their triumphs and minimize errors.

Antiseptics

Lord Joseph Lister (1827 - 1912) - regarded as father of modern surgery said, “skin is the best dressing”. In 1865 he decreased wound sepsis and failure rates in Glasgow Infirmary surgical unit by spraying operating rooms with diluted phenol.

This marked the genesis of pre-operative preparation for surgical rooms, patients and the surgeon. Consequently a variety of antiseptics and disinfectant evolved. Owing to some demerits, some have been dismissed while others have gained ground on basis of wound sepsis, wound failure or general skin reaction.

In 1867, Lister introduced active and successful antiseptic techniques to surgery and established guiding principles for good surgical practice. These principles were based on the work of Louis Pasteur, (a French chemist and bacteriologist) on microorganisms. In 1857 Pasteur had shown the infective powers of microorganisms and the way they were affected by heat and various antiseptics.
These principles were strongly supported by White (1891). He stated- “Every operator of prominence improved his results enormously as soon as he adopted “Listerism”.

The art of “Listerism” has nearly been perfected in the last century (20th). The use of antisepsis is no longer a question. May be the question is how long should a surgeon scrub or patient be scrubbed which actually is a hair splitting issue in prevention of wound failure.

Incisions
Wound dehiscence, evisceration’s and incision hernias have been associated with midline abdominal incisions in any age group.

This has led to formulation and popularisation of other abdominal approaches by various surgeons. Some of these incisions are therefore known by the names of these surgeons.

A transverse abdominal incision was first described in 1823 by Baudolocque for caesarean sections and was popularised by Pfannenstiel in 1900 for pelvic operations.

In 1899, Mayland first used this incision in upper part of abdomen and Boeckmann later used it in all types of abdominal operations.

One surgical researcher, Sloan, found that tension across a vertical incision is 30 times more than across a transverse incision.

However transverse incisions offers minimal access to abdominal viscera. This necessitated design of other incisions that would offer convenient approaches to organ or site of interest. Surgeons are therefore required to have thorough understanding of anatomy of area to be operated. One general rule was (and still is) incision should follow lines of Langer.
In 1861, Langer described skin tension lines on observation made on cadavers after puncturing the body with an awl. These lines are a variance of “wrinkle lines of Kraissl” 13.

In 1951 Kraissl stated that elective incisions should be made on normal wrinkle lines if possible (wrinkle lines are lines of least tension in the body) 13. There are however pragmatic reasons for making exceptions to this general rule e.g. where speed is of essence in an emergency or when access to a lesion is critical then the most direct incision is applicable. Woolsey (1898) recommended oblique and transverse abdominal incisions 14.

Theodore Kocher popularised right subcostal incision for liver, gall bladder and bile duct surgery while much later Rees and Colleen suggested that this incision should be abandoned in favour of upper midline because it cut through too many subcostal nerves 15.

**Intraoperative measures**

Over time surgeons have taken measures to reduce intraoperative causes of wound sepsis and failure.

**Gloves**

In 1858 - MacBurney, Kern and Johnson each published reduction in their infection rates after use of rubber gloves that had been introduced by Halsted. Paul Mikulicz is known to have changed gloves every two hours in long operations to keep infection rate low 8.

Today a variety of surgical gloves are available in the markets, which are safe for both the patients and the surgeon.
**Drains**

Markoe (1885) described capillary drainage of wounds by Catgut strands under iodoform and dichloride gauze. Sands (1885) also employed rubber drains and decalcified bone. Neuter however opposed use of drains in clean wounds because “they act as foreign bodies and invite infection,” he stated.8

Halsted stated – “To drain or obliterate with the greatest care of all dead spaces of wound is still an almost universally accepted precept of surgery.”8

**Antibiotics**

In 1939, use of sulphanilamide powder on surgical wounds was almost universal. It would be sprinkled in peritoneal cavity for peritonitis because it appeared to decrease morbidity. Today intravenous antibiotics have played their role well in reduction of wound sepsis and failure.11

**Instruments**

Retractors have also been designed to reduce tissue damage and skin ischaemia. Introduction of Endotherm (diathermy) knife by Kelly (1926) reduced over clamping of tissue.11

**Skin closure**

Wound closure techniques have evolved with evolution of closure materials. A wide variety of materials have been used through time. This include:

a. Silk
b. Linen
c. Cotton
d. Bark fibres
e. Kangaroo tendons and animal intestinal strands.
f. Horse hair

g. Driver ant heads (current concepts of staples).
h. Wires made of precious metals $^{11,16}$.

Gilles once stated - “How tight to tie is a matter of experience and lies between adequate edges apposition and that which cuts through by causing tissue necrosis” $^{11}$.

Disruption of abdominal wound was a particular problem with mortality often in excess of 50% in early last century. This was addressed in a special symposium by WC White in 1934 who recommend retention sutures of silk or preferable silver wire $^{17}$.

Melick (1942), a graduate student in surgery published the results on the use of Nylon suture, which evoked less tissue reaction than catgut or silk. This began the current era of synthetic sutures $^8$.

In 1912 Moynihan had stated the quality of ideal suture, which are listed below. He however did not mention anything to do with sizes. This was addressed by Forrester J in a paper-“Suture materials and their uses” $^{18}$

An ideal suture should be:

- Monofilament.
- Used for any procedure.
- Easy to handle.
- Have minimal tissue reactions.
- Have high tensile strength.
- Hold knots securely.
- Absorbable.
- Have predictable absorption pattern.
• Sterile.

In a more recent publication, W E G Thomas have revised the characteristics of an ideal suture and added that this suture should also be:

- Non-electrolytic
- Non-allergenic
- Non-carcinogenic
- Inexpensive
- Pulls through tissues easily
- Should not shrink in tissues

Currently most manufacturers aim at making ideal sutures using the above standards.

In 1947 Burch pointed out that early mobilization didn’t increase wound disruption.

Varma S and colleagues compared abdominal wound closure by continuous or interrupted suture. They recommended the former.

Abdominal wound disruption therefore occurs in varying rates and causes are multifactorial. Different western institutions have recorded different incidence, which shows minimal improvement in the first half of last century. Consider the following:

John Hopkins University:

- From 1889 to 1923 it was 0.18%.
- From 1923 to 1936 it was 0.86%.
- In 1954 it was as high as 5.8%.

As at 1988 - Burst abdominal rates were recorded as follows:

- University of Missouri -1.1%
- Middlesex Hospital, London - 1.5%
- St. Luke’s Hospital, Cleveland- 2.5%
- University of Tennessee, USA- 9.36%.
Surgical anatomy of anterior abdominal wall

Thorough knowledge of the anatomy of anterior abdominal wall is essential to the surgeon in order to achieve safe access to abdominal cavity, in siting of abdominal stomas, suprapubic urinary diversion and paracentesis.

Surface features

The general outline of anterior abdominal wall is hexagonal. It’s bounded superiorly by xiphoid process, superolaterally by costal cartilage’s of seventh, eighth, ninth and tenth ribs. The lateral boundaries on either side are the vertical midaxillary line that passes inferiorly to the summit of the iliac crest.

Inferiorly, from lateral to the medial aspect, the anterior abdominal wall is bounded by iliac crest, inguinal ligament, and upper surface of superior pubic ramus and pubic symphsis. The pubic tubercle, the pubic crest, the inguinal ligament, anterior superior iliac spine and the iliac crest are palpable landmarks in the lower abdomen.

There are a number of anatomical landmarks the surgeon should be familiar with and may be used as “roadmap” in planning incisions.

Xiphoid process is a palpable cartilaginous process in the inferior pole of the sternum and forms the apex of the vertical midline of the anterior abdominal wall. It’s from this point that the costal margins can be palpated. On the right side 8-10cm from this point marks the fundus of the gallbladder.

Umbilicus is an obvious landmark, which lies anterior to intervertebral disc of third and fourth lumbar vertebra in a young adult of average built. It’s naturally
inverted in most individuals. Abdominal incisions are often planned with no reference to it. It also does reveal some intraabdominal pathology in some individuals; e.g.:

- Apparent bruising sign (Cullen sign) may appear around the umbilicus in case of acute pancreatitis or rapture of ectopic pregnancy
- Hard umbilical nodule (Sister Joseph nodule) may signify gastrointestinal malignancy.
- Caput medusa – engorged subcutaneous veins may signify portal venous hypertension or caval obstruction.

**Inguinal ligament** is the in-rolled lower edge of external oblique aponeurosis. A mark 2cm above the midpoint of the inguinal ligament indicates position of internal inguinal ring.

**Layers of anterior abdominal wall.**

**Skin.**

The skin over the abdomen is relatively thin compared to that of the back. It’s more mobile and stretchable. Skin tension lines of the abdomen are disposed transversely. Above the umbilicus, they are horizontal while below it they run with a slight inferomedial obliquity. Incisions made on these lines heal without scarring while those across them result into heaped-up scars.

The blood supply to the skin is derived from internal thoracic artery (as superior epigastric artery) and cutaneous branches of musculophrenic artery superiorly. The terminal branches of posterior intercostal arteries supply the lateral aspects whereas the lower region is supplied by inferior epigastric artery, superficial
external iliac and superficial external pudendal arteries. Veins accompany the respective arteries.
The nerves to the skin are derived from cutaneous branches of seventh to twelfth thoracic nerves with first lumbar nerve innervating the lower abdominal skin as ilioinguinal and iliohypogastric nerves.

**Superficial Fascia**
The superficial fascia comprises two layers, that is the superficial fatty layer (fascia of Camper) and deep membranous layer (fascia of Scarpa). This fascia is quite prominent in children especially infants, where the surgeon may mistake it for external oblique aponeurosis in herniorraphy.
Superiorly Scarpa’s fascia becomes continuous with the posterior capsule of the breast (retromammary fascia). Inferiorly, it crosses inguinal ligament and about 1cm below it, it blends with Fascia Lata along the Holdens line, therefore extravasted urine in pelvic injuries can’t pass downwards into the thigh.
Below the pubic tubercle, it extends into penile shaft and into perineum to form Colle’s fascia. Laterally Scarpa’s fascia fades out at midaxillary line.

**Muscles of the anterior abdominal wall**
On each side of the midline are four large muscles, which are:
**Rectus abdominis**: - this muscle arises by two tendinous heads from the pubic bone. The lateral head from the lateral part of the pubic crest and the medial head from the pubic ligament. The fibres run upwards to be inserted to the fifth, sixth and seventh costal cartilage’s. The lower seven thoracic nerves innervate it.
Its enclosed by the aponeurosis of the other three flat muscles described below.
**External oblique**: - this muscle arises by eight fleshy slips from the lower eight ribs. These slips run forwards, downwards and medially to be inserted in an aponeurotic form to the xiphoid process, linea alba, pubic symphsis, and pubic crest. The lower fibres are inserted in the anterior two thirds of iliac crest. The lower six intercostal nerves innervate it.

**Internal oblique**: - the muscle arises from the lateral two thirds of the inguinal ligament, the iliac crest and the thoracolumbar fascia. The fibres run upwards, forward and medially (crossing the external oblique at right angles). Its attached to the four lower ribs and their cartilage’s, the xiphoid process, linea alba, pubic crest and pectineal line of pubis. The lower six thoracic and the first lumbar nerves innervate it. Its aponeurosis takes part in the formation of the Rectus sheath. Inferiorly it forms the conjoined tendon with the aponeurosis of transversus abdominis. Fibres of the cremaster muscle arise from it in the internal inguinal ring.

**Transversus abdominis** arises from lateral one third of inguinal ligament, anterior two thirds of iliac crest, thoracolumbar fascia and lower six costal cartilages. The fibres run horizontally and forwards and end in a broad aponeurosis which is inserted into xiphoid process, linea alba and pubic crest. The lower fibres fuse with internal oblique to form the conjoined tendon. It shares the same nerves as the internal oblique muscle.

**Linea alba** is the midline interdigitation of the aponeurosis of the external oblique muscle, internal oblique muscle and the transversus abdominis on each side of the abdominal wall.
Rectus sheath is the aponeurotic envelop that ensheathes the Rectus abdominis. The anterior and the posterior walls of the rectus sheath vary in their formation in superoinferior direction. These variations do not have significant surgical concern although good apposition of the same is necessary to avoid incision hernias.

**Abdominal cavity access**

*(Universal incision and their indications).*

Making abdominal incisions and closure of the same are some of the first things a surgeon in training is taught. The ability to safely access abdominal cavity makes an otherwise difficulty operation look easy. This is a fact that many surgical trainees have learnt when they have called their seniors for an “impossible” operation that is made easy by just enlarging the incision.

As mentioned earlier open abdominal surgery has a variety of approaches in terms of incisions. These incisions can be **vertical, horizontal** and **oblique**. The choice of incision depends on: -

- Easy access (universally accepted incisions).
- Diagnostic confidence.
- Personal experience.
- Patients build.
- Nature of operation.

**Vertical incision**

They have advantage in that: -

- They are quick and easy to perform.
- Can be easily extended for more exposure.
- Gives excellent access.
- Don’t interfere with possible stoma sites.
- Rarely are abdominal muscles cut.
The disadvantages are:

- They are less cosmetic.
- They are more uncomfortable.
- They have high rate of wound dehiscence (comparatively).

Examples of vertical incisions. (See illustration on page 22)\textsuperscript{21,22}.

1. Midline: - used for general laparotomy.
   It can just be upper midline (above the umbilicus) or lower midline - below the umbilicus.

2. Paramedian: - used for general laparotomy with bias that’s towards the side the incision has been made\textsuperscript{21,22,23}.

3. McEvedy: - used for repair of femoral hernias and can be extended into a Paramedian incision for laparotomy if the need arises\textsuperscript{22}.

Transverse Incisions: they are employed in elective surgery especially in the upper abdomen in situations where there are difficulties in access such as hepatobiliary surgery, pancreatic surgery, elective splenectomy and abdominal aorta aneurysm surgery. They are also quite popular in paediatric laparotomies.
Advantages.

- They are less painful because they usually involve one dermatome.
- They heal satisfactorily leaving acceptable scars
- Allow use of regional anaesthesia.

Disadvantages:

- Not adequate to access the whole peritoneal cavity.
- They are difficult to extend in case of unsuspected pathology.
- Cut through many blood vessels and muscles.

Examples of transverse incisions  (see illustration on page 22)

1. **Kocher’s incision** - (Right subcostal) used mainly for hepatobilliary surgery.

2. **Rooftop** – Left and right subcostal incision - used for elective spleenectomy where the spleen is large and adherent.

3. **Transverse** - used for surgery of Aorta, biliary structures, pyloromyotomy (in infants), and right colon.

4. **Gable Incision** - used for surgery of pancreas, liver and the adrenals 22.

**Oblique Incisions.**

These Incisions follow Langer’s lines and close few dermatomes. They may involve muscle cutting or splitting. They are used for both emergency and elective surgery.
Advantages.

♦ Cosmetically acceptable.
♦ Access to specialized areas for specialized surgery.
♦ Less painful.
♦ Allow use of regional anaesthesia.

Disadvantages:

♦ Muscle cutting or muscles splitting thus give rise to incision hernias.
♦ Incisions like Pfannenstiel, Lanz and Gridiron don’t allow full access to peritoneal cavity and thus some authors say they should not be regarded as laparotomy incisions 21.

Examples of oblique incisions. (See illustration on page 22)

1. Rutherford-Morrison - used in surgery involving ureters, kidneys, external iliac vessels, caecum and appendix on the right and sigmoid colon on the left.

2. Lanz - used in surgery of caecal pole and appendix - This incision gives good cosmetic results.

3. Gridiron –used in surgery of caecal poles, appendix and may be extended to a Rutherford - Morrisson incision for greater peritoneal access.

4. Pfannensteil Incision - used for pelvic operation especially in gynaecological surgery.

5. Thoraco-Abdominal. On the right it used for liver and portal vein surgery while on the left it used for lower oesophagus, stomach and spleen surgery 22.
UNIVERSAL ABDOMINAL INCISIONS

VERTICAL INCISIONS

- Xiphisternum
- Midline
- Paramedian
- Umbilicus
- McEvedy
- Pubic symphsis

TRANSVERSE INCISIONS

- Kocher
- Rooftop
- Gable
- Transverse

OBlique INCISIONS

- Thoracoabdominal
- Rutherford-Morrison
- Lanz
- Gridiron
- Pfannenstiel
**Wound closure techniques.**

Wound closure aims at minimizing risks of:

- Wound infection.
- Wound rapture.
- Incision hernia.
- Sinus formation.
- Adhesion of intestines to the abdominal wall with subsequent obstruction.

The procedure should be quick and easy with low incidence of post operative wound pain and respiratory complications and shouldn’t interfere with stomas.

In general primary closure of wounds should achieve:

- Careful apposition of wound edge.
- Avoidance of strangulation of tissues.
- Give mechanical support to the wound.
- Hold wound margins together until sufficient healing has taken place.

**Suture technique**

Suture technique determines the success of abdominal closure. These can mass closure or layered closure, continuos or interrupted sutures.

The choice of suture material is equally important. These can absorbable or non-absorbable, Monofilament or braided, synthetic or natural. An ideal suture should have properties as stated earlier in historic review but as relates to primary closure it should\textsuperscript{24,25,26}:

- Hold tissue in apposition for as long as the natural forces are insufficient to resist separation on stretching the wound edges.
- Should be easy to handle and should knot securely.
• Should provoke minimal tissue reaction.
• Should be quickly absorbed so that infection is not encouraged.
• Should not result in sinus formation.

**Mass closure**: usually used in midline incision. This suture technique involves peritoneum, and rectus sheath within the same needle bite. The suture should be placed at least 1cm intervals between successive throws. The suture technique also employs continuos suture other than interrupted suture. Strong sythetic non-absorbable sutures are employed (i.e. No.1 polyamide suture).

**Layered closure** - used for transverse and paramedian Incision. Incision hernias are more common with layered closure as opposed to mass closure.

**Continuous suture.** Its now almost universal practice to close Laparotomy incision by continuos sutures.

Advocates of continuous sutures claim that sutures equalize tension differences between individual sutures and thus distribute tension along wound, more evenly. Jenkins demonstrated that with continuous suture, a suture to wound length of 4:1 gives the least would tension if placed 1cm from wound margin and at 1cm intervals 27,28.

**Tension sutures** - are hardly used for primary laparotomy closure but some surgeons’ advocate it to “belt and brace” layered abdominal closures 11. This practice however has been overtaken by use of prophylactic intraabdominal absorbable (polyglactine 910 –BP) mesh 29.

**Interrupted sutures** - are hardly used for laparotomy wound closure today and thus not given much attention except in reference to wound failure.

**Wound healing**
The healing of acute primarily closed wound usually follows a predictable pattern under normal circumstances. There are four phases of wound healing.

- **Inflammatory phase**: (first to fifth day).
  Platelets adhere to collagen exposed by damage to blood vessels to form a plug. The intrinsic and extrinsic coagulation cascade generates fibrin that combines with platelets to form a clot in the injured area. Initial vasoconstriction mediated by catecholamines is then followed by vasodilatation mediated by histamine, Prostaglandin E2, ProstaglandinI2, serotonin and kinins. Neutrophils appear in the wound within 24 hours.

- **Migratory phase**: (fifth to eighth day).
  Additional inflammatory cells, fibroblasts and other mesenchymal cells migrate into the wound. Gradually macrophages replace neutrophils as the predominant inflammatory cells. Antigenic factors induce the development of new blood vessels. Epithelial cells advance across the wound area from the basal layer of the epidermis. The fibrin-platelet clot dehydrates to form a scab.

- **Proliferative phase**: (seventh to fourteenth day).
  Advancing epithelial cells close the wound area. New capillaries form. The wound strength grows as result of steadily increasing production of collagen and glycosaminoglycans by fibroblasts. Myofibroblasts induce wound contracture.

- **Scar remodelling**: (fourteenth day to complete healing)
Level of collagen in the wound plateaus.
Old collagen is broken down as new collagen is produced.
The number of cross-links between collagen molecules increases and the new collagen fibres are aligned so as to provide a gradual increase in wound tensile strength.
New capillaries combine to form larger vessels.
The epithelium is healed although it never quite regains its normal architecture.
When a wound follows the above phases of healing it has healed by first intention.
Other forms of healing are:
Healing by second intention where the wound fails to heal by first intention due to infection, excessive trauma tissue loss or imprecise approximation of tissues. In this case, granulation tissue containing myofibroblast form in the wound closing it by contracture. Healing process is slow and large scar tissue usually forms.
Healing by third intention also referred to as delayed primary closure occurs when two surfaces of granulation tissue are brought together surgically.
This is a safe method of repair for contaminated wound as well as infected traumatic wounds with extensive tissue loss and a high risk of infection.

**Factors influencing wound healing.**
These are classified into local factors and general factors.

**Local factors**
- Good surgical technique which involves meticulous haemostasis, gentle handling of tissues, elimination of dead spaces, and avoidance of tissue damage by excessive diathermy or strangulation by ligatures
- Good blood supply.
- Adequate mechanical strength.
- Suitable suture materials.
- Acceptable suture technique.
Avoidance of local sepsis.
Avoidance of radiation.
Adequate immobilization of the wound.

**General factors.**

- Patient age: - old age is associated with high incidence of wound failure due to possible malnutrition, impaired circulation, altered metabolism, chronic illnesses and loss of skin elasticity and muscle tone.
- Patient’s weight : -excess fat at the wound site may prevent securing good closure , reduce blood supply and act as a good media for sepsis
- Nutritional status.
- Dehydration and /or hypovolemia.
- Immune status.
- Chronic illnesses.
- Malignancies.
- Social habits e.g. smoking or excessive consumption of alcohol.

**Causes of Laparotomy wound failure**

There are a number of already identified factors that influence wound healing and can therefore act as causes of wound failure.

These factors are classified into two:
- Local factors
- Generals factors

**Local factors:**
**Mechanical stress:** Wound disruption may be caused by extensive forces affecting wound tension or may be a consequence of excessive movement of wound edges. Common causes of mechanical stress are - coughing, vomiting, gaseous distension of gut, sneezing and prostatism.

**Blood supply:** Good blood supply is a basic factor in the sites of wound repairs. Factors which compromise blood supply include; infection, accumulation of haematoma, seromas, vasoocclusive diseases associated with something and diabetes mellitus 31.

Surgical technique: this relates to

- Gentle handling tissues.
- Meticulous haemostasis.
- Elimination of dead space.
- Avoidance of tissue necrosis from excessive use of diathermy or strangulation of tissue by ligatures.
- Adequate debridment of devitalised tissue.
- Removal of foreign materials.

The failure to observe one or more of the said techniques constitute a barrier to cellular repair and tend to propagate wound infection.

**Suture material:** The choice of suture material in wound closure has significant bearing on the success of wound repair. Ideally to avoid wound failure a suture should 26: -

- Hold tissues in apposition as long as the natural forces are insufficient to resist separation on stretching the wound edges.
- Should be easy to handle and should knot securely.
- Should provoke minimal tissue reaction.
- Should be quickly absorbed so that infection isn’t encouraged.
Should not result in sinus formation.

**Suture technique:** In general causes of wound failure as relates to suture technique involve:
- Poor apposition of wound edges.
- Strangulation of tissues.
- Poor selection of suture materials.
- Poor spacing of suture from wound edges and too close to each other. (Insertion of sutures should be 1 cm from wound edges).
- Poor selection of needles for closure of abdominal layers.
- Early removal of suture.

**Local sepsis:**
- This prolongs the inflammatory phase.
- Compromises the blood supply.
- Toxic effects of bacterial by products inhibit local healing.

**Immobilization of the wound:** Lack of adequate immobilization reduces skin apposition and disrupts healing.

**Radiation:** Interferes with normal protein synthesis, mitosis, and migration of inflammatory factors and maturation of collagen. It destroys small blood vessels leading to fibrosis and vicious cycle of local hypoperfusion and hypoxia.

**General factors:**
**Patient age:** with aging both skin and muscle tissues loses tone and elasticity; metabolism also is slow and circulation is impaired. There is associated high incidence of malnutrition, vitamin deficiency and other chronic illnesses. All these factors lengthen healing time and predispose to wound disruption \(^{33}\).

**Patients’ weight** - excess fat at the wound site may prevent securing a good closure due to the fact that: -

- Fat does not have a good blood supply therefore poor perfusion.
- Fat necrosis secondary to use of diathermy is good media for sepsis.

**Nutritional status:**
- Deficiencies in carbohydrates, protein, Zinc and Vitamins A, B and C can impair the healing process.
- Adequate nutrition is essential to support cellular activity and collagen synthesis at the wound site.

**Dehydration / Hypovoleamia.**
Dehydration and electrolyte imbalance can affect cardiac function, kidney function, cellular metabolism, and oxygenation of blood and hormonal function. These effects will not only impact upon patients overall health and recovery but also impair the healing process.

**Immune response**
Immunodeficiency seriously compromises the outcome of surgical procedure. Patients who have infective (acquired immunodeficiency syndrome) or therapeutic (steroid’s, chemotherapy) immunosuppression have relative poor wound healing \(^{34}\).

**Concomitant chronic disease.**
Patients who suffer chronic illness will be more vulnerable to post surgical complications. These include those who have diabetes mellitus, uraemia, jaundice, and chronic obstructive airway disease e.t.c.

**Presence of malignancy and paraneoplastic syndromes** may alter cellular structure and also influence surgeon’s choice of methods of closure and closure materials.

**Smoking** is associated with poor wound healing due to vasoocclusion of microvasculature.

**Alcohol:** - chronic consumption of alcohol is associated with poor wound healing. May be due to associated malnutrition.

**Management of acute wound failure.**

One should be able to first recognize clinical manifestations of wound failure in order to institute appropriate immediate management. These include the following.

- Around fifth to eighth postoperative day, the patient may present with serosanginous discharge from the suture line. This discharge is in large volume.  

- Patient may present with evisceration of the small gut or momentum.
- Patient may complain of feeling of “give way”.
- Other features may include, anxiety, dehydration and tachycardia

**Immediate management.**

- Establish intravenous access for rehydration.
- Administration of opiate analgesics.
- Commence broad-spectrum antibiotics.
- Cover eviscerated abdominal contents with sterile gauze soaked in warm saline and then cover wound with sterile towel as one prepares the patient for emergency closure.
- Nasogastric tube insertion to decompress the stomach and avoid aspiration.
- Allay anxiety by sedating the patients.

Patient is then taken to theatre and under general anaesthesia and adequate muscle relaxation, thorough peritoneal ravage should be done with copious amounts of normal saline.

Closure of the wound with through and through retention sutures of Non-absorbable monofilament Nylon (No. 1 or 2), taking large bites (3-4cm) from wound edges. Plastic tubing’s are used to protect skin from suture pressure. Retention sutures are combined with layered closure.

**Prevention**

Prevention starts with good preoperative management as well as postoperative care. These include:

- Adequate rehydration.
- Prevention of vomiting by starving patient at least 4-6 hrs before surgery and insertion of Nasogastric tube to prevent abdominal distension.
- Adequate analgesia to prevent restlessness.

Intraoperative measures to be taken have been mentioned earlier. It has been proposed that a wound length to suture length ratio of 1:4 give an adequate bite (1cm) of tissue in each side of musculo-aponeurotic layer of laparotomy wounds, (Jenkins Rule)\textsuperscript{27,28,37}. 
♦ With a continuous suture, there is an equalization of tension and minimization of tissue strangulation, along the wound length (layered or mass closure) with less chance of knot slippage and knot sinuses.

♦ Sutures of adequate strength should be used (No.1 or 2).

♦ Sutures for laparotomy closure should be synthetic polymers or non-absorbable (polyamide or polypropylene) or absorbable (polyglactin or polydioxanone) type. The absorbable suture needs to retain integrity with a half-life of several weeks (chromic catgut was dismissed as it failed in this respect) 38.

JUSTIFICATION OF THE STUDY

Laparotomy wound dehiscence remains a disturbing surgical complication. It’s obvious that general surgery almost always involves abdominal surgery and therefore laparotomy wound dehiscence remains an unspoken concern of many surgeons. In Kenyatta National Hospital, this problem does occur in some patients undergoing abdominal or pelvic surgical procedures. Surgeries are both emergency and elective and involve obstetrics, gynaecological and general surgical problems.

The problem definitely prolongs patients’ hospital stays incurring unexpected costs to both the patient and the hospital. Above all else, is the fact that there’s psychological and social set back where both the patient and relatives tend to resent the health care provider and ignore the achievements of the initial surgery. This reflects badly on the surgeon and the institution.

Therefore the cost burden, the psychological trauma and social implications calls for reduction if not elimination of the problem.
STUDY OBJECTIVES

Broad objective

The broad objective was to determine the magnitude of laparotomy wound dehiscence, its causes and the outcome following its management.

Specific objectives

♦ To establish and classify the main causes of laparotomy wound dehiscence.
♦ To establish the mode of management of the condition over the study period.
♦ Highlight possible indicators of wound dehiscence.
♦ Determine the outcome of the management.

MATERIALS AND METHODS

Study design

It’s a descriptive, retrospective study that covered a five-year period (June 1996-May 2001). It was carried out in Kenyatta National Hospital.

Study population

The study population involved patients who developed wound dehiscence following laparotomy within the study period.

Methodology

A proposal for the study was submitted to Kenyatta National Hospital Ethical and Research Committee. The committee approved the study.
A proforma questionnaire was used to retrieve information from patients’ files.
The files were obtained from Medical Records Department using Diagnosis Codes Index and from Theatre Operation Register. Information obtained was handled confidentially. Classification of the patients was as per demographic data, urgency of initial surgery, suspect aetiology, mode of management and outcome of the management.

**Inclusion criteria**

Patients undergoing surgical, obstetrical and gynaecological operations within the study period were included.

**Exclusion criteria**

All the patients whose files had inadequate data or were missing were excluded from the study.

**Data Management and Analysis**

All data obtained from medical records was entered into a proforma questionnaire. At analysis, each item in the questionnaire was analysed separately using the tally method. Chi-square ($\chi^2$) test was performed where necessary. Different data presentation methods (pie charts, bar charts e.t.c) were used for all the study parameters and presented in the results.

**Study Limitations**

1. Variation in expertise for all procedures done. It was noted that the seniority of surgeons varied but a long-standing practice is that the assistant surgeon (usually the senior house officer) closes the wound, thus it was difficult to directly implicate senior surgeons in wound failure.

2. Variation in departmental practices and policies. The study involved patients in both surgical and obstetrics / gynaecological departments.
RESULTS
A total of 92 files were obtained of which 6 were excluded from the study due to inadequate data and thus only 86 patients formed the study population. Of the six patients that were excluded, two were ladies who had under gone Caesarean section in two different district hospitals and were referred to Kenyatta National Hospital when they developed wound dehiscence. The referral notes did not contain data of interest as relates to this study. The other four lacked information on type of suture materials used in closure of the abdominal wound. The 86 patients included in this study were fully managed in Kenyatta National Hospital from the initial surgery and the results that follow represent the findings involving this group.

FIGURE 1.

The age range was 11-75 years with a mean age of 32 years. Majority of patients were within the 21-30 age group (49%). (Figure 1).
There were 16 males and 70 females with abdominal wound dehiscence. This gives a male to female ratio of 1:4. (Figure 2).

Emergency operations were done on 83% (71) of the patients whereas 17% (15) were operated as elective procedures. (Figure 3).

$\chi^2$ test performed (at p-value 0.01 and 1 degree of freedom) for relationship between urgency of surgery and wound failure showed that patient undergoing emergency procedures had a greater risk of having wound failure than those undergoing elective surgery.
The presenting complaints were abdominal pain (58%), fever (20%), vomiting (10%), weight loss (6%) and cough (6%). (Figure 4).

None of these complains occurred in isolation. Each patient had at least two of the above complains.
Clinical evaluation revealed pathological abdominal distension was the most frequent finding (14 patients). (Figure 5).

Mothers undergoing caesarean section had physiological abdominal distension this was not considered as clinical sign.

Dehydration and fever were the other common physical findings while wasting, abdominal masses and tachycardia occurred in a few patients.
Anaemia (low haemoglobin) was a frequent preoperative comorbidity taking up 76% (30/39) of clinical comorbidities that were associated with wound dehiscence in this study. Malignancies (8%), uraemia (7%), chest infection (3%), diabetes mellitus (3%) and jaundice (3%) to a little extent did contribute to the list of implicated comorbidities. None of the patients was on steroid therapy, radiotherapy or cytotoxic treatment.

**Human Immunodeficiency Virus (HIV) serostatus**

Only 21%(18) patients had their serostatus checked. Of these, 5% (4) were seropositive, 16%(14) were seronegative and 79%(68) of the patient were not investigated for HIV infection.
Pelvic surgeries (using abdominal approaches) carried the highest wound failure rate i.e. 81%(70) of the afflicted patients.

Gastrointestinal surgery was associated with 17% (15) of the dehisced wounds while only 1%(1) of the patient who had abdominal surgery that neither involved GIT nor pelvis i.e. splenectomy. (Table 1)
In the preoperative investigations, 35 (40%) of the patients had low preoperative haemoglobin i.e. haemoglobin less than 10g/dl, 3 (3.5%) of the patients were ureamic whereas only 1 (1%) had electrolyte derangement. (Figure 7).

**FIRST SURGERY VERSUS REPEAT SURGERY.**

The number of patients undergoing laparotomy for the first time was 75 (87%). Those who had undergone laparotomy previously (for a similar or different indication) were 11 (13%).

**SENIORITY OF THE SURGEON**

Consultant surgeons and senior registrars operated on 14 out of the 15 elective patients. All the emergencies and one elective procedures were done by senior house officers. However owing to the common practice where the assisting
surgeon tends to be the one who closes the incision, seniority was not considered as an important variable. More over senior house officers are the assisting surgeons to their seniors.

INCISIONS SITINGS

Patients who were operated through vertical (either midline or paramedian) incisions were 79 (92%). The other 7 (8%) had transverse incisions.

PERITONITIS

Only 16 (19%) patients had peritonitis at the time of initial laparotomy. The other 70 (81%) had no clinical signs of peritoneal infection.

TABLE 2. SUTURE MATERIAL USED FOR CLOSURE OF RECTUS SHEATH.

<table>
<thead>
<tr>
<th>NAME</th>
<th>TYPE</th>
<th>DESIGN</th>
<th>SIZE</th>
<th>NUMBERS</th>
<th>PERCENTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catgut</td>
<td>Natural</td>
<td>monofilament</td>
<td>1 &amp; 2</td>
<td>61</td>
<td>71%</td>
</tr>
<tr>
<td>Vicryl</td>
<td>Synthetic</td>
<td>braided</td>
<td>0- 2.0</td>
<td>20</td>
<td>23%</td>
</tr>
<tr>
<td>Nylon</td>
<td>Synthetic</td>
<td>monofilament</td>
<td>2.0- 2</td>
<td>5</td>
<td>6%</td>
</tr>
</tbody>
</table>

Table 2 summarises suture preferences, their sizes, type and designs as were used in this study.

ABDOMINAL CLOSURE METHOD

Layered closure (88.4%), where peritoneum, rectus sheath, subcutaneous fat and skin were stitched separately was more commonly used than mass closure (9.3%).

Two patients (2.3%) had poor wound closure where rectus sheath was not sutured at all in one patient and the other had misalignment of wound margins i.e. rectus sheath was not sutured together appropriately.
DRAINS AND NASOGASTRIC TUBE

No drains were used in 69 (80%) of the patients while in the other 17 (20%) a variety of drains (passive tubes, corrugated rubber and vacuum drains) were used. Only 19 (22%) had nasogastric tube insertion postoperatively.

FIGURE 8

Majority of the patients (55%) had wound disruption occurring between the sixth to tenth postoperative day. There were only six (7%) patients who had dehiscence after the fifteenth postoperative day. (Figure 8).
FIGURE 9.

The possible leading cause of wound disruption in this study was wound infection (48 patients). Serosanguinous exudate was the leading indicator of impending dehiscence (42 patients).

All the patients received analgesic postoperatively, while 75 patients received antibiotics. The other 11 patients did not receive any antibiotics. (Figure 9).

MODE OF TREATMENT OF DEHISED WOUNDS
The 17 patients who had partial dehiscence were all managed conservatively. These are patients whose dehisced part did not involve rectus sheath.

The other 69 were taken back to theatre for relaparotomy and closure of the wounds.

FIGURE 10.
As demonstrated above, the relaparotomy findings varied. In a descending order (from most frequent to the least frequent) they were peritonitis, damaged sutures, cut fascia margins loose sutures, early removal of sutures, haematoma and poor wound closure technique. (Figure 10).

**ABDOMINAL CLOSURE IN REPEAT SURGERY**

There were 69 patients who were taken back to theatre, 57 of them had mass closure of their abdominal wound, with insertion of tension sutures in 24 of them. The other 12 had layered closure with insertion of tension sutures in all of them. All these patients received antibiotics and analgesics.

**FIGURE 11. OUTCOME.**
The average hospitalisation duration was 25 days with a range of 5 - 153 days.

There were two deaths:

1. A 30 years old female who was diabetic, she had haemoglobin of 3.8g/dl postoperatively and overwhelming sepsis. She had undergone laparotomy for a pelvic abscess.

2. A 31 year old male with HIV infection and spontaneous colonic perforation.

No patient developed wound dehiscence again (in the ward or after discharge).

Follow up in the study group was erratic with most patients not being reviewed after one month of discharge. In all the files reviewed there were no recorded complications of the repaired wounds or those managed conservatively. (Figure 11).
DISCUSSION

This study reviewed 86 patients who had laparotomy wound dehiscence over a five-year period from June 1996 to May 2001. Of the 92 patients who had laparotomy wound dehiscence, 6 were excluded from the study due to inadequate data. Thus only 86 patients were included giving a wound failure rate of 4.3% (86/2002).

The total number of laparotomies done in this period was 2008. The number of patients, who recovered, was 1797, while 211 died. This gives case mortality of 10.5% for primary laparotomy. However only 2 out of the 86 patients in this study died. The mortality rate in the study group was therefore 2.3% (2/86).

This study has analysed the possible causes of wound dehiscence, the management of these patients preoperatively, intra-operatively, postoperatively and evaluated the outcome of each case.

Laparotomy wound failure rate of 4.3% is much higher than reported in a number of recent studies of similar respect.

Niggebrugge A and Hansen B reported a failure rate of 1% (45/3768) in patients who had undergone midline laparotomy in a 5-year period (1986-1990) 39.

Bucknall TE et.al reported failure rate of 1.7% (19/1129) in patients who had undergone major laparotomies over 5 year period (1975-1980) 40.

The possible explanations for such big discrepancy may due to the fact that majority of the patients were done as emergency operations. Emergency surgery is a risk factor to wound disruption in that, being a life saving procedure there is hardly any time to adequately stabilise patients and more often than not, the chronic health status may not be an immediate priority. In this study unavailability and/or wrong choice of suture materials and right antibiotic cover may also have contributed to the high failure rate. Ian Capperauld stated 36- “The choice of suture material is frequently motivated by emotional rather than scientific thought
process. Choice is dictated by what historically the surgeon was taught by his Chief who in turn emulated his Chief. This decision process could, therefore, be well out of date by a period in excess of 50 years”.

Senior house officers who are surgical trainees usually do these operations. Krause R 41 said that incidence of relaparotomy is high in training institutions and also depends on the type of health facility.

The mean age was 32 years with a range of 11 to 75 years.

The male to female ratio was 1:4 (16:70).

The youngest patient was a boy who had dehiscence of a Lanz (appendectomy) incision. The 75-year-old patient was a man with a recurrent rectal prolapsed and had undergone rectopexy.

The highest number of patients’ (42) was within 21-30 years age group, which can be explained by the fact that most of these patients were women within reproductive age group who had undergone Caesarean section.

This sharply contrasts with other studies done elsewhere, where laparotomy wound dehiscence occurs in an older age group and afflicts men more than women.

Madsen G and Fischer L reviewed 198 patients with burst abdomens and reported a median age group of 66 years with a male to female ratio of 2.5:1 42.

Naturally the life expectancy in Kenya is lower than in Denmark where the quoted study was carried out and on average not many patients live long enough to contribute to a median age of above 65 years in Kenya.

It was however noted that all the four patients who were above 70 years were men. Therefore similar statistics may be obtained with improvement of life expectancy and if the practice of using catgut sutures in closure of rectus sheath in patients undergoing Caesarean section is abandoned in favour of other suitable suture materials. The age distribution is therefore determined by several factors,
these are, age group affected by the primary condition necessitating the initial laparotomy and the overall studied population.

In this study 71 (83%) patients were operated as emergencies and 15 (17%) as elective cases. All the emergency operations and one elective surgery were performed by senior house officer (SHO) while 14 out of 15 elective laparotomies were performed by consultants surgeons or senior registrars. As mentioned in the results, the seniority of the operating surgeon could not be considered as a significant variable due to the regular practice where the assisting surgeon (more often than not, the SHO) closes the incision. However using Chi-square ($\chi^2$) Test, it was shown that emergency surgery lead to higher wound failure rate than elective surgery in this study. This is where the computed $\chi^2$ value (36.47) at 1d (degree of freedom) at p-value 0.01 was greater than the expected value of 6.63 from the chi-square distribution tables. Therefore the null hypothesis (that emergency surgeries do not lead to greater wound failure than elective surgeries) was rejected and the alternate hypothesis (emergency surgeries lead to greater wound failure than elective surgeries) was inferred.

Madsen G and Fischer L stated that emergency surgery did not influence the outcome as related to wound failure. This is so because surgical principles should not vary whether one is dealing with an emergency or an elective procedure.

However Chukudebule WO and Okafor EL reported the risk of burst abdomen to be three times greater in “unbooked” patients.

The commonest presenting symptom was abdominal pain (47%). Pain is a nagging symptom and not many patients will tolerate it and therefore it is the
main reason why many patients will seek medical attention. Fever is an indication of infection and 16% of the patients had it. The other symptoms included vomiting, cough and weight loss.

Clinical evaluation of these patients confirmed the complains. In this study, 16% of the patients had abdominal distension, 13% were clinically febrile, 13% had tachycardia and were dehydrated, 10% had palpable abdominal masses and 5% were clinically wasted.

These variations in symptomatology indicate that presentation was both acute and chronic in nature. However this wasn’t useful in determining which patients would have wound dehiscence because the better fraction of the patients did not have most of them and still had wound disruption.

In the series by Madsen G and Fischer L the complicating illness prior to surgery did not affect the outcome of surgery\(^\text{42}\), whereas Bucknall et al\(^\text{40}\) did mention old age, male sex, obesity, chest infection and abdominal distension as pre-operative risk factors to wound dehiscence.

However in surgical practice it is necessary to stabilise the patient first prior to surgery thus the physical findings like dehydration, anaemia and low blood pressure should be corrected prior to surgery.

Roe P G outlines the hazards of presenting a patient for surgery with existing fluid deficits. He therefore emphasises the need to collect fluid imbalance before operation\(^\text{45,46}\)

Clinically, 30 patients were found to anaemic (low haemoglobin) whereas 35 had low haemoglobin (below 10g/dl) as per laboratory findings. In this study this is considered as one of main contributors to wound failure.

Low haemoglobin means poor oxygen supply to tissues and therefore poor tissue healing and inability to resist infection.
One of the patients who died in this study had low pre-operative haemoglobin. Haemoglobin before her death was 3.8g/dl.

Simon J S and Lorna M W report that mortality and morbidity are significantly increased in patients who undergo surgery with preoperative haemoglobin of less than 8g/dl and receive no transfusion.\(^47\)

Three patients had high urea pre-operatively. This may have been due to dehydration because electrolytes were within normal ranges. All patients except one had normal electrolytes. This is in keeping with surgical practice of correcting electrolyte imbalance before surgery and thus this might have been achieved through replacement therapy.

There were 3 patients with malignancies i.e. carcinoma of oesophagus, adenocarcinoma of stomach and endometrial carcinoma. Whereas no evaluation as relates to the effects of neoplastic or paraneoplastic syndrome were done, it’s common knowledge that patients with malignancy are emaciated (especially carcinoma of oesophagus and stomach) usually with anaemia and hypoproteinemia. These patients pose a great challenge in terms of recovery from anaesthesia, predictability of outcome of surgery and ability to fight infection. Some authors encourage oral or stomal nutritional supplement before surgery is attempted.\(^48,49\)

Soran A et al mentioned hypoproteinemia as risk factor for abdominal wound dehiscence in their study.\(^6\)

One patient had diabetes mellitus, one had pneumonia and one had jaundice. These factors are mentioned in the literature review as possible causes, but statistically the numbers are quite low (1%) in this study for any useful inference to be made. No patients were undergoing radiotherapy, cytotoxic or steroid...
therapy. These factors are known to cause poor tissue healing and were therefore included in the study.

In this study 18 patients were tested for human immunodeficiency virus (HIV) and only 4 were seropositive. The other 14 were seronegative. The other 68 patients were not tested. From this kind of statistics it would be difficult to conclude whether HIV infection in isolation affects tissue healing and therefore no inferences were made as relates to HIV infection.

Seymour I S et al reports that, patient with HIV infection and AIDS generally do not have difficulty with wound healing. The wound complications found in AIDS patients have not been properly defined neither have a direct relationship between leukocyte defect and wound healing have been reported. Jellis J reported that, appendicitis, gynaecological pelvic abscesses and primary peritonitis are common in patients with HIV infection. These patients present with difficulties in surgical wound healing due to the existing infection.

Patient who had pelvic surgery accounted for 83% (70) of all dehisced wounds and 67 of them had midline incisions. The other 3 had transverse incisions. Midline incisions are preferred in emergency surgery for they offer better access to abdominal cavity including the pelvis and can easily be extended. Transverse incisions are not good in this respect, however they can be used for elective pelvic or abdominal surgery where diagnosis is certain and outcome of surgery is predictable. The 3 patients who had dehiscence of transverse incision following pelvic surgery drew the concern of the investigator because these types of incision hardly gape.

One of these patients had Pfannenstiel incision for prostatectomy. He started leaking urine through the incision, which finally gaped. The other two had modified Pfannenstiel incision for Caesarean section, while trying out new
technique (Misgav Ladach method) of doing Caesarean section. Failure then in this situation can be attributed to learning curve.

Pelvic operations done involved Caesarean section (58%), pelvic abscess (10.4%), hysterectomy/myomectomy (9.3%), ectopic pregnancies (2.3%) and prostatectomy (1%).

No patient's undergoing Caesarean sections had drains or nasogastric tubes postoperatively. Only 2 patients who had pelvic abscess drainage had vacuum drains left in the pelvic cavity. This shows that use of drains was quite limited in this study.

No drains are needed in clean abdominal operations. But when infection is present, resection or aspiration of involved tissue should be followed with antibiotic ravage and peritoneal cavity should be drained 52.

In case of severe sepsis a narrow strip of corrugated drain may be placed in the abdominal cavity through a separate wound and then close the wound loosely around it. Tube drains tend to block in thick pus or in presence of debris 53.

Soran A et al in their study on burst abdomens stated that two or more drains increased risk of wound dehiscence and so did no drains at all 6.

Larsen JV et al wrote a paper on wound dehiscence after caesarean section and stated that postpartum haemorrhage increased wound dehiscence significantly 54.

In this study gastrointestinal surgery was associated with wound failure in 15(17%) patients. Peritonitis was a leading cause of emergency exploratory laparotomy followed by intestinal obstruction, appendectomies and penetrating abdominal injury. Two patients with gastrointestinal malignancies were operated electively. All the approaches were through vertical incisions. These incisions were either midline or paramedian. One patient who had appendicitis was operated through a Lanz incision that gave way after discharge from hospital.
Vertical incisions are known to give way more frequently than any other type of abdominal incision \(^5\).

Makela JT et al associated wound dehiscence with midline laparotomy \(^10\).

All the patients except the one who had undergone appendectomy had drains and nasogastric tubes. This shows that nasogastric tubes and drains may not prevent wound dehiscence in presence of infection although they are helpful in abdominal distension caused by temporary ileus.

Graham DJ et al in the paper, “The association of intra-abdominal infection and abdominal wound dehiscence”, pointed that intra-abdominal infection and colonic surgery were a leading cause of wound dehiscence \(^5\).

After the initial surgery most patient’s (88%) had layered closure of the abdominal wound. The rectus sheath was the layer of interest in this study because it maintains the integrity of abdominal wall after surgery.

In 71% of the patients the rectus sheath was closed using catgut suture. In 23% of the patients vicryl was used and in the other 6% nylon was used. This shows that the choice of suture material was governed by either the operating surgeon or by availability and not necessarily by principle. Ian Capperauld says, suture materials are the commonest implants used by surgeons and therefore thorough knowledge of their properties is a must for every surgeon \(^3\).

Poole GV et al suggested that closing midline abdominal fascial wounds with a running nylon suture might be a superior method of closure in clean incised wound \(^56\).

Layered closure results in significantly more burst abdomen than any other method of closure \(^3\).

Most (55%), of the wounds dehisced in the sixth to tenth postoperative day. This duration is within the period quoted by other similar studies. Anielski et al \(^5\).
reports average time of 6.5 days while Madsen et al \textsuperscript{42} reported the sixth postoperative day.

Wounds that dehisced within the first 5 days accounted for 29%. This is due to technical failure of wound closure. The other 16% of the wounds dehisced after eleventh day. This was mainly due to infections and after removal of sutures.

The leading postoperative causes of wound dehiscence were wound infection and peritonitis (45 patients). Infection interferes with wound healing and thus in the presence of the same there is increased incidence in dehiscence. Most studies do quote wound infection, presence of peritonitis, colonic surgery and pelvic abscess as possible contaminants of the incision leading to dehiscence \textsuperscript{2,3,4,27}.

Another indication of impending dehiscence is serosanginous exudate. As mentioned earlier gastrointestinal surgery has to be accompanied by nasogastric tube to reduce abdominal distension in case of transient ileus, which does occur regularly after intraabdominal surgery.

In this study 3 patients developed constipation and 10 developed a cough. The cough may have been due to endotracheal intubation. However these symptoms did not occur in isolation and cannot be wholly blamed for wound dehiscence although they are capable of causing the same.

Eight patients had suture removal before the wound gained sufficient strength and thus there was complete dehiscence. Six patients had high blood pressure a possible post operative factor. Two patients had incisional haematoma while another two had poor incision margins approximation. Other comorbidities included typhoid fever (1), vesicovaginal fistula (1), psychosis (1) and thyrotoxicosis (1). All these factors may have contributed in one way or another to the wound failure.
There were 69 patients who were subjected to relaparotomy while 17 had conservative management. Conservative management involved dressing of the wound regularly until it healed. Some did require insertion of skin sutures under local anaesthesia in the ward treatment room.

Dodson M K et al pointed out that superficial skin closure of extrafascial wound dehiscence appear to be superior to deep en bloc closure in terms of time and pain control. These benefits are achieved with minimal risks while allowing timely wound healing 58.

Of the 69 patients who were taken to theatre for relaparotomy, 34 were found to have peritonitis, 25 had damaged suture, 18 had cut fascia margins, 13 had loose sutures and 6 had dehisced gut. As regards to failed suture or suture technique, it would be worthwhile to mention that this is inexcusable in the current surgical practice where litigation is on the increase against the profession. Cliff Snyder 25 said it all in 1972- “The faults in making sutures are the manufacturers, the errors in using them are surgeon’s”.

Other findings were haematoma and poor closure. Those who had loose sutures damaged suture or cut fascia margins were 56 in total. This presented technical failure where sutures were either poor, stitching was poorly done (too tight or too close to fascia edge or loosely tied).

The purpose of suture is to hold a wound together in good apposition until natural healing process is sufficiently well established to make the support from the suture material unnecessary and redundant 26,59.

During relaparotomy, 57 patients had mass closure of the abdominal wound, with 24 of them having tension sutures. The other 12 had layered closure and tension sutures. The suture used this time round to close the rectus sheath was nylon suture. All the patients received antibiotics and analgesics.
As regards to tension suturing, Eden C G recommends use of a strong Nylon suture to be inserted in all layers of the wound at 3cm from wound edge and at 3cm interval without undue tension over polyethylene bars and to be retained for 10 to 14 days. Niggebrugge A et al suggest that a continuous monofilament, nonabsorbable suture should be used to close a laparotomy incision. Stretchable suture material, loop sutures, and the continuous figure of eight technique should all be investigated.

Paye F et al compared the use of polyamide mesh applied externally to skin and intraperitoneal polyglactine 910 resorbable mesh for treatment and prevention of wound dehiscence. They concluded that use of intraperitoneal mesh reduced rate of dehiscence significantly (4% versus 13%) and lowered the frequency of reoperation in eviscerated patients (25% versus 61%). All patient studied had one or more risk factors of evisceration.

Although no meshes were used in this study, the work by Paye F and colleagues shows that the use of “prophylactic” absorbable mesh may go along way in reducing laparotomy wound dehiscence in suspect patients in institution plagued by this surgical complication.

The average hospitalisation duration was 25 days with a range of 6 days to 153 days. The patient who stayed the shortest had burst abdominal within few hours after laparotomy. He was taken back to theatre and repaired immediately. He was discharged on 6th postoperative day.

The patient who stayed 153 days is a young lady (30 years), who had ureteric injuries following drainage of pelvic abscess. She had to undergo a series of urological procedure before she was finally discharged.

Anielski et al reports an average hospitalisation of 35.9 days.
The patients in that particular study are much older with an average age of 61.8 years and this can explain the prolonged hospitalisation.

Two out of eighty six patients died (2.3%). This mortality is much lower than reports in other series.

Madsen G et al 42 reported a mortality of 24%. Again most of the patients in these series were old, median age 66 years, and thus they may have had debilitating illnesses. In this study most patients had uncomplicated primary surgery and were relatively younger, therefore recovery was fast and uneventful after wound repair. Of the two patients that died one was a young man 31 years, who had spontaneous colonic perforation. He was also HIV seropositive. The other was 30-year-old lady who was a known diabetic with pelvic abscess. Post operatively she developed severe sepsis and had haemoglobin of 3.8g/dl.
CONCLUSION

On the basis of the findings of this study the conclusion is:

1. Laparotomy wound dehiscence has multifactorial causes. These include certain indications of laparotomy (e.g. peritonitis), intra-operative technique and post-operative cormorbidities and factors.

2. The commonest cause in our set up is anaemia, post-operative infection and choice of inappropriate suture materials. Catgut suture should not be the suture of choice for closure of rectus sheath. It was widely used in this study.

3. Surgical drains and nasogastric tube should be put when sepsis and ileus are expected.

4. Women in the reproductive age group were more at risk than any other patient category.

5. More technical training is needed for surgeons handling emergencies to minimise on technique error.

6. Not all patients should be subjected to relaparotomy. Those with partial or extrafascial wound dehiscence can be managed conservatively.

7. Hospitalisation period is quite long though within limits of other studies of similar respect.
RECOMMENDATIONS

A protocol should be formulated and availed to personnel managing surgical patients who need laparotomy. In the protocol it should clearly stipulated the best approaches for various abdominal and pelvic surgery, choice of suture materials, style or method of wound closure and when to put drains and nasogastric tube.

- Resolve any controversy as relates to abdominal closure in the presence of severe abdominal contamination, peritonitis and gross distension.

- Avail the right surgical equipment especially suture materials to improve on preventable technical failure. The need for use of intraabdominal absorbable mesh to prevent wound dehiscence should be evaluated.

- Encourage supervision (and/or consultations) of junior members of the surgical fraternity by their seniors.
APPENDIX I

QUESTIONNAIRE

A five-year retrospective study on causes, pattern of presentation, management and outcome of Laparotomy wound dehiscence in KNH (June 1996 - June 2001)

Inpatient number ........................................

Gender (sex) ...................................................

Age group (in years)

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Count</th>
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<tbody>
<tr>
<td>0 - 10</td>
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<td>41 - 50</td>
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<td>51 - 60</td>
<td></td>
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<tr>
<td>61 - 70</td>
<td></td>
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<tr>
<td>&gt;70 years</td>
<td></td>
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</tbody>
</table>
Urgency of initial surgery.

Emergency
Yes  [ ]  No  [ ]

Elective
Yes  [ ]  No  [ ]

Symptoms at first presentation.

Fever  [ ]

Abdominal  [ ]

Wasting  [ ]

Cough  [ ]

Vomiting  [ ]

Physical findings:

Temperature (febrile)  [ ]

Tachycardia (pulse)  [ ]

Wt loss / wasting  [ ]

Dehydration  [ ]

Abdominal Distension  [ ]
Abdominal Masses

**Clinical Comorbidities:**

- Anaemia (haemoglobin)
- Uremia
- Diabetes Mellitus
- Jaundice / liver disease
- Malignancies specify……………………
- Radiotherapy
- Steroid therapy
- Cytotoxic
- Chest infection specify……………………

Human Immunodeficiency Virus (HIV) serostatus

Indication of first surgery (specify)…………………………………………
## Investigations (pre-operative)

<table>
<thead>
<tr>
<th></th>
<th>Level</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Haemoglobin</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urea</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Serum Sodium (Na⁺)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Serum potassium (K⁺)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Serum (Cl⁻)</td>
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</table>

- **First surgery**
  - [ ]

- **Repeat surgery**
  - [ ]

## Incisions

<table>
<thead>
<tr>
<th>Type</th>
<th>Transverse</th>
<th>Oblique</th>
<th>Vertical</th>
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</thead>
<tbody>
<tr>
<td>S I T I N G</td>
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</tbody>
</table>

**Presence of Peritonitis**
- positive [ ]
- negative [ ]
Sutures used for closure abdominal wall

<table>
<thead>
<tr>
<th>Name</th>
<th>Number</th>
<th>Natural</th>
<th>Synthetic</th>
<th>Monofilament</th>
<th>Braided</th>
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</thead>
<tbody>
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</tbody>
</table>

Layered closure          [ ]

Mass closure             [ ]

Use of drains -not used  [ ]

-Used                    [ ]

Use of nasogastric tube - used [ ]

-Not used                [ ]
Postoperative day when dehiscence occurred.

Duration in days.

<table>
<thead>
<tr>
<th></th>
<th>Present</th>
<th>Absents</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 5</td>
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<tr>
<td>6 – 10</td>
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<tr>
<td>11 – 15</td>
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<tr>
<td>&gt;15</td>
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</table>

Possible postoperative factors

<table>
<thead>
<tr>
<th></th>
<th>Present</th>
<th>Absents</th>
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</thead>
<tbody>
<tr>
<td>Wound Infection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abdominal distension</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Serosanginous Exudate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surgical drains</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N - G tube</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constipation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coughing</td>
<td></td>
<td></td>
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<tr>
<td>Cormobodities (specify)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antibiotics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analgesics (opioid / NSAIDS)</td>
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</table>
Mode of management

Conservative

Operative

Operative findings

<table>
<thead>
<tr>
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<th>Present</th>
<th>absent</th>
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<tbody>
<tr>
<td>Infection / Peritonitis</td>
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<tr>
<td>Loose Sutures Knots</td>
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<tr>
<td>Damaged suture</td>
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<td></td>
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<tr>
<td>Cut Fascia Margins</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distended Gut</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others Specify</td>
<td></td>
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</table>

Abdominal closure

<table>
<thead>
<tr>
<th></th>
<th>sutures</th>
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<tbody>
<tr>
<td>Layered closure</td>
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<tr>
<td>Mass closure</td>
<td></td>
</tr>
<tr>
<td>Tension sutures</td>
<td></td>
</tr>
<tr>
<td>Antibiotics</td>
<td></td>
</tr>
<tr>
<td>Analgesic (specify) opioid / NSAID:</td>
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</table>
### Outcome:

Days of hospitalisation

<table>
<thead>
<tr>
<th>Days of Hospitalisation</th>
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</thead>
<tbody>
<tr>
<td>0 - 10 days</td>
<td></td>
<td></td>
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<tr>
<td>11 - 20 days</td>
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<tr>
<td>21 - 30 days</td>
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<tr>
<td>&gt;30 days</td>
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<tr>
<td>Died</td>
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</table>
APPENDIX II
Definitions of terms.

**Dehiscence** (from a Latin word, *dehiscere* that means to gape) means splitting open.

**Wound dehiscence** means separation of the layers of a surgical incision.

**Lapar** is a Greek word meaning flank (sometimes loosely but correctly used in reference to the abdomen).

**Laparotomy** means surgical incision made at any point of the abdomen to gain access to peritoneal cavity.

**Chronic laparotomy wound failure** refers to weakness of the incision site after the epithelium has healed. This presents clinically as incisional hernia.

**Sepsis** is an infective process leading to tissue decomposition.

(Definitions are from **DOLARD’S illustrated medical dictionary**).
References.


