An audit of emergency hernia operations: Surrogate of system failure or incidentalomas?

by

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Declaration

I, **Boitumelo Nkgudi**, hereby declare that the work on which this dissertation/thesis is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university.

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TABLE OF CONTENTS

Page

PART A: Study protocol 5

PART B: Structured literature review

Literature search strategy 15
Objectives of literature review 16
Definition and classification 17
Groin Hernias 18
Presentation of Groin hernias 19
Ventral hernias 20
Anatomical Considerations 21
South African Context 24
Management of Hernia emergencies 25
References 29

PART C: Publication ready original manuscript

Title page 33
Abstract 34
Article 35
References 48

Part D: Supporting documents

Author guidelines of South African Journal of Surgery 52
Departmental Research Committee approval 57
Human Research Ethics Committee approval 58

Part A:

Study protocol

An audit of emergency hernia operations: Surrogate of failure or Incidentalomas?

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Contents

1. Introduction
2. Motivation
3. Objectives
4. Method
    1. Sample selection – inclusion and exclusion criteria
    2. Data collection and Analysis
5. Ethical considerations
6. Confidentiality
7. Indemnity
8. Sponsor
9. Funding

10. Audits

11. Publication Policy

12. References

1) Introduction

Hernia is defined by the protrusion of peritoneal organs through the aponeurotic defect of the abdominal wall.[1] Hernia emergency is a common encounter of the general surgeon and is associated with high morbidity and mortality. These emergencies occur when the hernia is complicated by incarceration (in which the hernia contents cannot be reduced back into the peritoneal cavity), bowel obstruction or strangulation (in which case the blood supply to the hernia contents is compromised and may lead to visceral ischaemia and necrosis).[1,2]

Emergency surgical care of these patients involves resuscitative efforts to address the life-threatening problems and can have an impact on the type of hernia repair. The goal is always being to perform the safest and most durable repair, the gold standard of which involves mesh repair. Where there is contamination with bowel content or active sepsis, the surgeon may be forced into a tissue only repair and or an expensive biological prosthesis and accept higher rates of reoccurrence and the need for reoperation at a later stage .[3]

The different types of hernias that can develop around the abdominal cavity of the adult patient have varying propensities to complicate, and these include, in order of frequency and rate of complications: groin (femoral, indirect and direct inguinal); ventral (incisional, epigastric, periumbilical, paramedian); diaphragmatic (congenital and acquired) and very rarely internal, lumbar and pelvic floor.[1]

Groin Hernias

It is currently estimated that around 20 million patients will undergo groin hernia operations annually.[2-5] These make up around 70% of all abdominal wall hernias. 96% of groin hernias are inguinal and 4% femoral. Men have a lifetime risk of groin hernia occurrence of 27% versus 5% in women. Femoral hernias, which occur more frequently in women, have the highest rate of complications and thus always need surgery as soon as the diagnosis is made; whereas inguinal hernias can be managed electively if uncomplicated and symptomatic. [4]

Risk factors for emergency presentation of a complicated groin hernia include those with multiple hernia related admissions, female gender and right sided hernias.[1]

Diagnosis of is most often made clinically, which radiological investigations (ultrasound and CT) reserved resolution of diagnostic doubt.[1]

Factors that are contribute to higher morbidity and mortality include

- Patient factors
    - ASA class 3/4
    - Age greater than 65
    - comorbidities
- factors that lead to delays
    - Prolonged symptom duration
    - Delay in presentation, diagnosis and institution of surgical treatment
- Hernia complications
    - Bowel obstruction
    - Perforated necrotic segments of bowel in the hernia sac
    - Need for laparotomy in addition to a groin incision.[1, 2, 4-7]

To date, there are many uncertainties regarding the optimal surgical approach in the emergency setting of a complicated groin hernia, with the open approach still considered the

safest in the latest international guidelines. There is low level evidence suggesting that with the laparoscopic approach, Transabdominal approach may be safer.[2]

The also still remains the question of whether mesh (and which mesh) can be safely used in the setting of a clean contaminated wound, one where strangulation has occurred and there has been a need for bowel resection and anastomosis. Hentati et all in their systematic reviews of studies done to answer this question concluded that mesh repair in this setting may be safe but did not recommended the use of mesh because of the current low level of evidence.[6]

Ventral Hernias

Hernia of the anterior abdominal wall can be congenital or acquired, 20% of which present as emergencies. The risk of an incisional hernia is estimated to be around 10-15 % following an abdominal incision and can increase to 23% in those who develop surgical site sepsis.[8,9] An estimated 20% of incisional hernias present as an emergency and are associated with poorer outcomes. Incarceration and strangulation are less common in the setting of a very small hernia defect (<1cm) or if there is a very wide neck, allowing for viscera to move in and out of the sac without compromise. The natural history of ventral hernias is that of progressive enlargement, they eventually cause symptoms and invariably complicate .[1,2] A policy of watchful waiting for incisional hernias in patients with severe comorbidities is sometimes employed. However, this can lead to a more complicated emergency presentation and poorer surgical outcomes.[10]

Surgical repair in the emergency setting is further compounded by considerations such as types of meshes to use in the setting of strangulated viscera, loss of domain and the need for component separation and creation of skin flaps for adequate abdominal wall reconstruction in the very large ventral hernias.[8,9]

2) Motivation

Emergency hernia surgery is associated with increased morbidity and mortality for the patient; it is technically more challenging for the surgeon and results in higher costs. A review of the factors that lead to the emergency presentation could expose those that are amenable to improvement and better outcomes.

3) Objectives

The primary aim is to elucidate patient and system factors that are associated with emergency presentations. Our secondary aim is to document morbidity and mortality associated with emergency repairs.

4) Methods

This is a retrospective Case review.

4.1) Sample selection

Patients who presented with a Hernia emergency to the Acute Care Surgery unit from January 2014 to January 2019 will be included in the study.

Inclusion criteria:

1. Age > 13
2. Admitted to ACS from Jan 2014 to Jan 2019
3. Acute presentation of hernia requiring urgent surgical intervention

Exclusion criteria:

1. Elective hernia surgery

4.2) Data Collection and Analysis

Appropriate patients will be drawn from the electronic operative reports database. Data will be captured manually onto an excel spread sheet from patients' folders and electronic theatre notes.

Captured data will include:

- Patient demographics –age, gender
- Comorbidities and risk factors : Smoker, weight and BMI, DM (HbA1C), COPD, Chronic liver disease, steroid use –ongoing or intermittent, ASA classification, previous surgery
- Any prior visits to Surgical Out Patient Department / or hospital admissions (secondary level surgery consult) – date and number of visits
- Any CHC visits previously related to hernia – date and number of visits
- Any prior elective repair booking/ cancellations (reasons for cancellation- optimisation vs time issue) – date of consultation when booking was made
- Special investigations (CT or ultrasound) – reasons for request; findings such as hernia location and defect size
- Presentation - incarceration, bowel obstruction, or strangulation
- Operative approach and type of hernia repair (groin vs ventral) (open, laparoscopic) (mesh yes/no) type mesh (synthetic /biological) , bowel resection and anastomosis
- Length Of Stay in days
- Complications using the Clavien-Dindo classification.

Data analysis:

Categorical data will be presented using frequency tables with percentages. Chi-square tests will be conducted where appropriate to test for association between categorical variables. Continuous data will be summarised in terms of means and standard deviations together with confidence intervals and t-tests for comparison of group means will be used to test for significance.

5) Ethical considerations

Due to the retrospective nature of this study, ethical considerations are largely limited to the confidentiality of data captured from the patient's records. During the study period data collection sheets will be in the possession of the researchers. Anonymity of patient information will be adhered to throughout out the duration of the study including data analysis and publication of results

6) Confidentiality

The Principal Investigator will preserve the confidentiality of participants taking part in the study in compliance with data protection legislation.

Anonymity will be ensured with the use of a master code which will be kept in a separate secure filing cabinet. All computers will be password protected.

7) Indemnity

UCT holds a non-negligent harm insurance policy which applies to this study.

8) Sponsor

UCT will act as the main Sponsor for this study. Delegated responsibilities assigned to the research team running this study will be documented.

9) **Funding: Nil**

10) **Audits**

The study may be subject to inspection and audit by UCT CRC under their remit as Sponsor and other regulatory bodies to ensure adherence to South African Good Clinical Practice if required.

11) **Publication Policy**

Authorship will be based on substantial contribution to conception, design, analysis, interpretation of data, drafting and approval of the version to be published.

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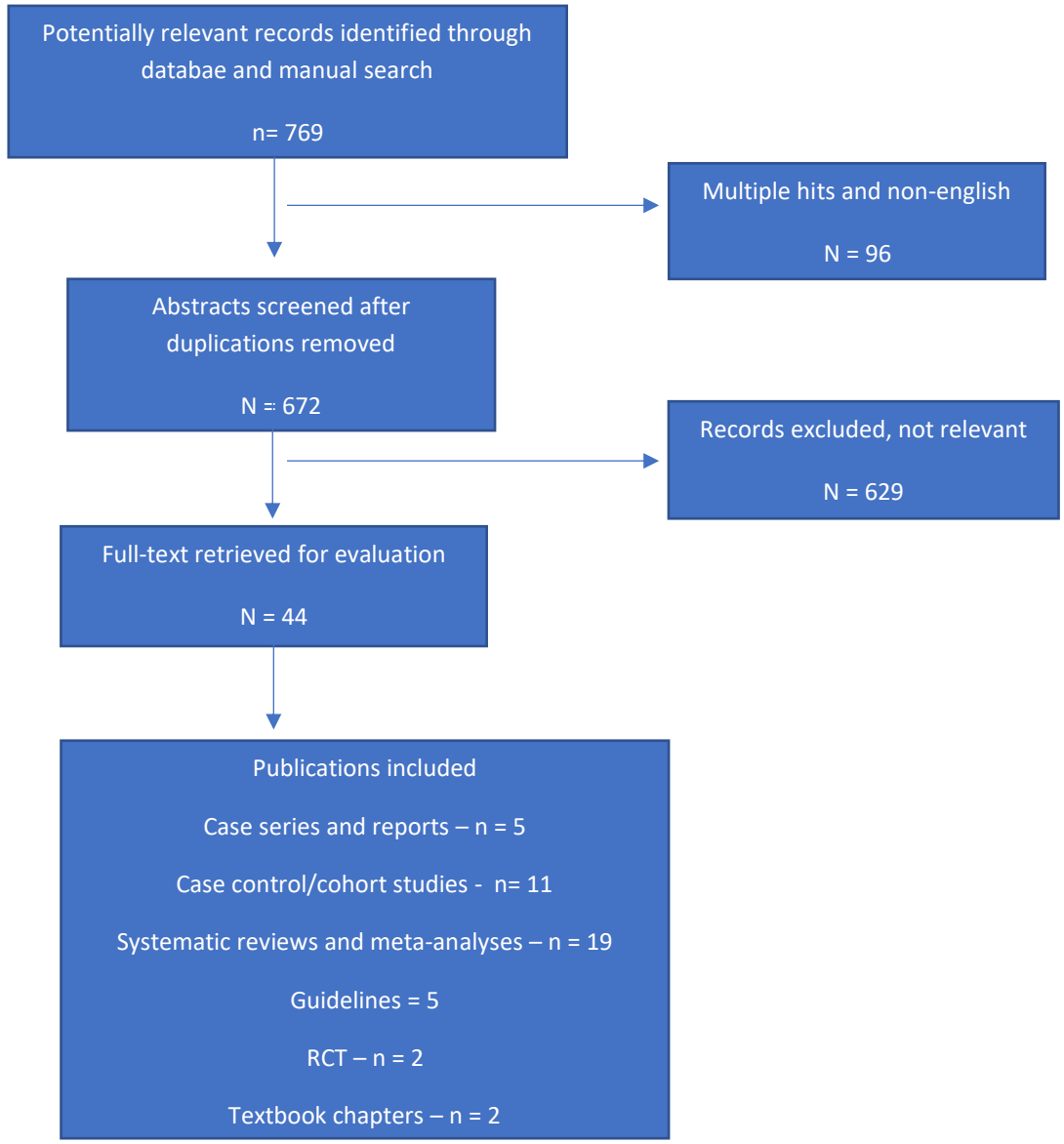
Part B:

Structured literature review

Literature Search Strategy

A structured literature review was performed searching the electronic databases of Pubmed and Google Scholar using the search thread “acute hernia presentations” OR (emergency hernia presentations) OR (emergency hernia repair). A further focused search was made for the relevant anatomy



Objectives of literature review

Abdominal wall hernias are a common presentation to the general surgeon. It is estimated that around 4% of adults above the age of 45 have hernias, indeed the incidence increases with age as the connective tissue become weakened.[1] Hernia is defined as the protrusion of peritoneal organs through the aponeurotic defect of the abdominal wall, and 70% of these are located in the groin. The treatment of hernia dates back to the 15th century by the Egyptians, the history and can be divided into eras. From the 15th to 17th century, hernia pathology was clarified, from the 17th to 20th century the anatomical basis was described and finally from the mid 20th century to date, the tension free repair technique evolved.[2] The majority of abdominal wall hernias present electively as a visible lump or pain. When Hernias present emergently, they are associated with increased morbidity and cost.[3] These emergencies occur when the hernia is complicated by incarceration (in which the hernia contents cannot be reduced back into the peritoneal cavity), bowel obstruction or strangulation (in which case the blood supply to the hernia contents is compromised and may lead to visceral ischaemia and necrosis).[4]

The purpose of this review is to discuss common issues relating to the emergency management of hernias. In this setting, and after resuscitative efforts to address life threatening problems, subsequent hernia repair can be complicated by the size of defect and loss of domain, or by the viability of the contents and associated need for bowel resection and anastomosis; all with the goal of providing the most durable repair, the current gold standard being a mesh repair.[5]

Definitions and Classifications

The different types of hernias that can develop around the abdominal cavity of the adult patient have varying propensities to complicate, and these include, in order of frequency and rate of complications: groin and ventral.[4,5,6]

Groin Hernias

Broadly speaking, groin hernias can be divided into indirect inguinal, direct inguinal and femoral. It is currently estimated that globally, around 20 million patients will undergo groin hernia operations annually.[5] These make up around 70% of all abdominal wall hernias. 96% of groin hernias are inguinal and 4% femoral. Men have a lifetime risk of groin hernia occurrence of 27% versus 5% in women. Femoral hernias, which occur more frequently in women, have the highest rate of complications and thus always need surgery as soon as the diagnosis is made; whereas inguinal hernias can be managed electively if uncomplicated and symptomatic.[4,5,8] The pathophysiology of hernias is said to involve an imbalance of proteases and antiproteases resulting in weakness of the connective tissues of the abdominal wall, and this can be exacerbated by increases in intra-abdominal pressure especially seen in chronic cough, prostatism and constipation.[1]

Inguinal Hernias

These hernias can be direct or indirect. In Indirect hernias, the sac protrudes through a dilated internal ring, an opening in the transversalis facia, which is located lateral to the inferior epigastric artery.[4] Once the sac and contents have protruded through the internal ring, they follow the tract of the spermatic cord and nerves within the inguinal canal towards and scrotum. The inguinal canal runs obliquely between the external and internal inguinal rings.

The internal inguinal ring is a funnel-shaped opening in the transversalis fascia; while the external inguinal ring is formed by fibres of the external abdominal oblique aponeurosis.[9]

The inguinal canal is made of a floor, anterior wall, posterior wall, and a roof. The floor of the canal that is made of the inguinal ligament, a thickened inferior portion of external oblique aponeurosis. The anterior wall is made of the external oblique aponeurosis. The posterior wall is made of the transversalis muscle. The roof is made of the combined fibers of the internal oblique and transversus abdominis muscle and the conjoint tendon. The conjoint tendon constitutes the main part of the medial portion of the posterior wall.[9,10]

A direct inguinal hernia is one where peritoneal content protrude through a weakening in the transversalis muscle, which the Hasselbach triangle. Typically, this weakening is related to advancing age and raised intra-abdominal pressure. The lateral border of the Hasselbach triangle is formed by the medial border of the inferior epigastric artery, the base is formed by the inguinal ligament, and the medial border by the lateral border of the rectus muscle.[9,11]

Femoral Hernia

In a femoral hernia, the peritoneal contents protrude through the femoral ring. This ring opens into the femoral canal; which is bound anteriorly by the inguinal ligament, lacunar ligament medially, the femoral vein laterally, and the pectineal ligament posteriorly. The tight nature of the opening, which is bordered by strong ligaments, makes it more susceptible to incarceration and strangulation.[4] Femoral hernias account for 5% of groin hernias and most frequently occur in women. Their diagnosis can be marred by the deep and inferior nature of the femoral ring

and this can lead to delays in diagnosis. Because of their tendency to complicate, it is generally recommended that they be repaired urgently.[4]

Diagnosis of groin hernias

The diagnosis of groin hernias is made based on typical history and clinical examination findings. One needs to be aware of the differential diagnosis, which includes lymphadenopathy, ectopic testes, abscess, soft tissue masses and saphena varix. There is generally no need to clinically differentiate between an indirect versus a direct hernia as the surgical management, both open and laparoscopic remains the same. In the setting of diagnostic uncertainty, as in the case of a suspected reoccurrence without obvious clinical findings, then an ultrasound is the first mode of investigation. There is a limited role for cross sectional imaging.[4,5]

Presentation

Groin hernias most frequently present as a lump or groin pain.[1] A watchful waiting approach can be employed in the asymptomatic, but most of these will eventually become symptomatic and thus require surgery.[12] Incarcerated hernias are those that cannot be reduced, there either present as acute pain or bowel obstruction. Strangulated hernias are those with ischaemic or non-viable small or large intestines within the hernia sac.[1] It is estimated that 5% of groin hernias will present emergently, either incarcerated or strangulated, and have a life-time risk in the young patients of 0.27%. In the elderly, those above the age of 70, the life-time risk of a complicated hernias is estimated to be in the region on 0.03%. Patients who present with symptoms of pain can be managed electively. Patients who present with femoral hernias require urgent surgical treatment due to its propensity to complicate.[4,13]

The diagnosis of groin hernias can be made on history and clinical examination with a sensitivity of 92% and a specificity of 93%. Where there is diagnostic doubt or concern of a reoccurrence ultrasound imaging, computed tomography (CT) or magnetic resonance imaging (MRI) can be used to clench the diagnosis.

Ventral Hernias

Ventral hernia is defined as a defect of the aponeurotic layers of the anterior abdominal wall with or without a lump. The clinical presentation of these hernias can vary from small incidental defects, to giant and complicated hernias with loss of domain. The symptoms range from minor cosmetic issues, to severe pain and to life-threatening conditions such as bowel obstruction, incarceration, and strangulation. These hernia's can be congenital or acquired. Congenital hernias typically present in the umbilical and paraumbilical region, the epigastric region, and laterally along the linea semilunaris, the Spigelian hernia. The risk of an incisional hernia is estimated to be around 10-15 % following an abdominal incision and can increase to 23% in those who develop surgical site sepsis.[4,14] An estimated 20% of incisional hernias present as an emergency and are associated with poorer outcomes. Risk factors for incisional hernias include, surgical site sepsis following a laparotomy, multiple operations in the same site, malnutrition and obesity, advancing age, steroid use, smoking and chronic obstructive pulmonary disease (COPD), aneurysmal disease and other connective tissue diseases, renal failure, liver failure, presence of other hernias, immune suppression and diabetes.[14-18]

Anatomical considerations

The abdominal wall is comprised of a complex fusion of overlapping layers of muscle and their aponeurotic layers designed to contain abdominal viscera. The abdominal wall consists of a pair of rectus abdominis muscles and a triple layer of laterally located muscles – the external and internal obliques and the transverse abdominis muscles.[9]

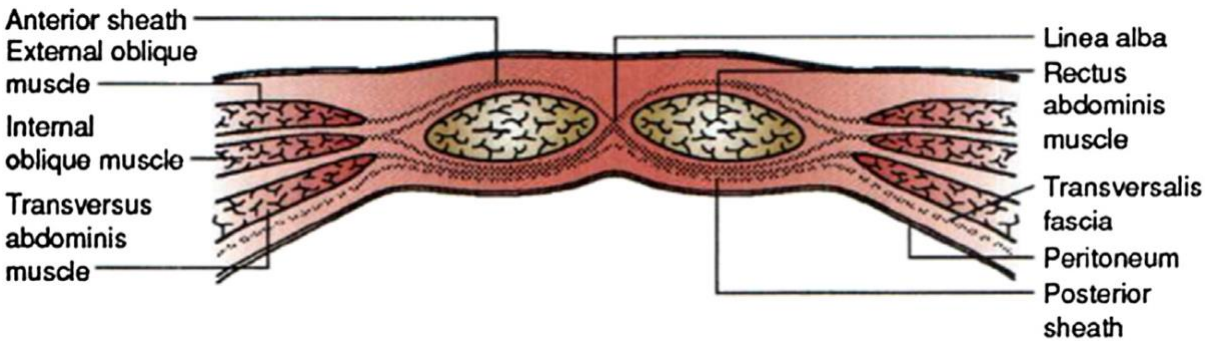


Fig2. The picture depicts the different layers that make up the anterior abdominal wall.[9]

Definitions and Classification

Ventral hernias can either be congenital or incisional, these are classified and defined by their position in the anterior abdominal wall and whether they result from previous surgery or not:

- Subxiphoid hernias refers to hernias that occur within 3 cm of the xiphoid bone.
- Epigastric hernias refer to hernias that occur 3 cm below the xiphoid bone and 3cm above the umbilicus, these comprise about 25% of congenital hernias.[14]
- Paraumbilical hernias are those that occur 3cm above and below the umbilicus, while Umbilical hernias are those that occur at the umbilicus; these comprise about 70% of all congenital hernias.[14]
- Infra-umbilical hernias occur 3cm below the umbilicus. [14]

- Suprapubic hernias are those that occur 3cm above the symphysis pubis; these are most commonly incisional in nature.[14]
- Spigelian Hernias occur lateral to the midline as a defect most commonly where the linea semilunaris and the arcuate ligament meet; they typically cause pain without a visible lump.[19]

Incisional hernias are those that occur following a laparotomy incision, laparoscopic port incisions and stomal sites. Parastomal hernias are those associated with stomal sites, these are the most common complication of long-term stomas.[20]

Incarceration and strangulation are less common in the setting of a very small hernia defect (<1cm) or if there is a very wide neck, allowing for viscera to move in and out of the sac without compromise. The natural history of ventral hernias is that of progressive enlargement, they eventually cause symptoms and invariably complicate.[4,13,14] A policy of watchful waiting for incisional hernias in patients with severe comorbidities is sometimes employed; however this can lead to a more complicated emergency presentation and poorer surgical outcomes.[4,14,15,21]

Surgical repair in the emergency setting is further compounded by considerations such as whether or not to use mesh and the type of meshes to use in the setting of strangulated viscera. Repair is also complicated by loss of domain and the need for component separation and creation of skin flaps for adequate abdominal wall reconstruction in the very large ventral hernias.[4,13-15,22]

As with groin hernias, history and clinical exam can clinch the diagnosis, with US and cross-sectional imaging used in the setting of diagnostic doubt or for operative planning. The gold

standard for managing ventral hernias is with tension free mesh repair, only on this occasion, placed in the retro rectus plain. This easily performed with the open approach. With the growing trend towards laparoscopic ventral hernia repairs, mesh is used intraperitoneally, with suture closure of the hernia defect.[14,15]

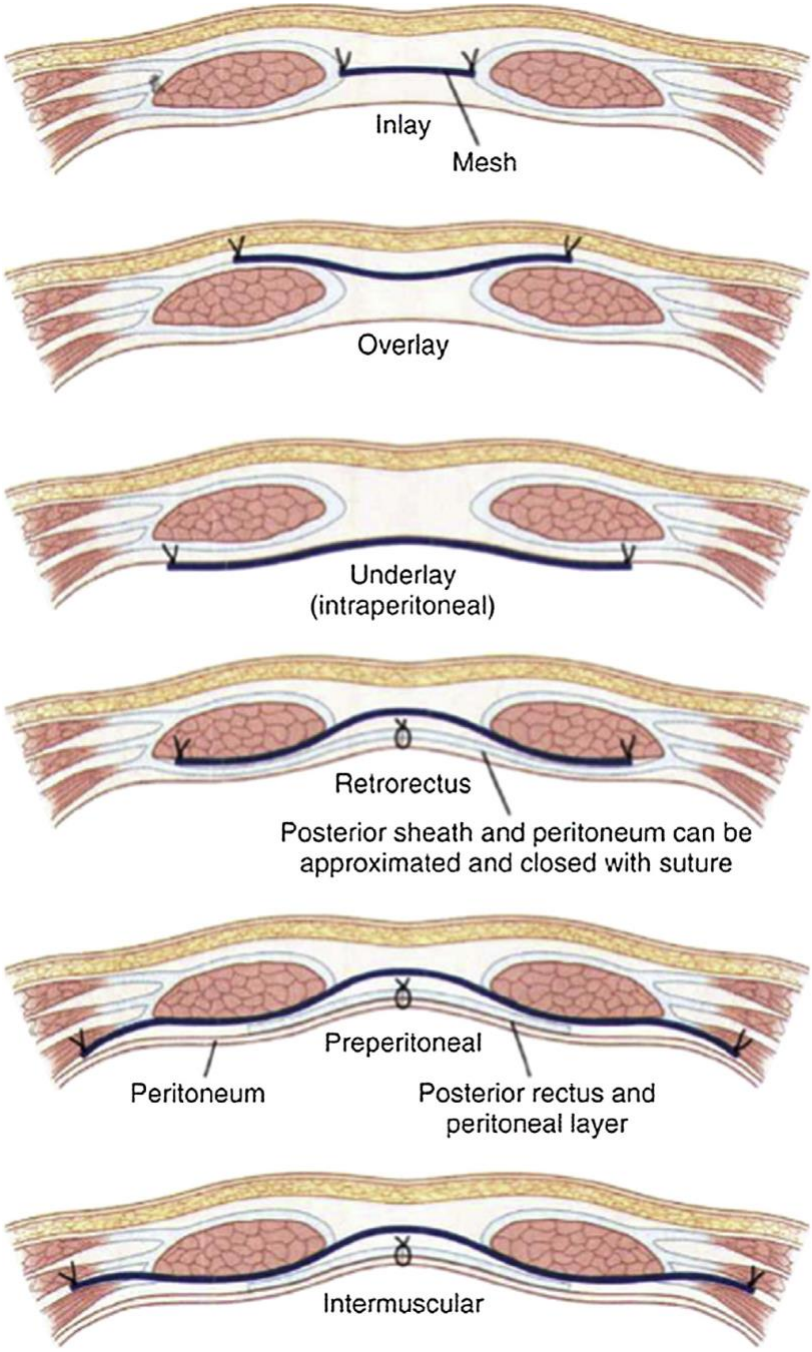


Fig 3. Above image depicts the various positions mesh can be placed in relation to the rectus sheath and muscles.[4]

There may be a place for suture repair in the very small hernia defects of less than 2cm.[4,14] Larger hernia defects, those greater that 10cm or with associated loss of domain, may require component separation, a procedure that involves an incision along the aponeurosis of the external oblique anteriorly or the aponeurosis of the internal oblique muscles posteriorly.

South African context

With the focus on communicable diseases there's concern that a surgical disease such as hernias have received minimal focus, this evident in the lack of data and poor documentation of surgical diseases. The renewed focus by global surgery initiatives will hopefully shine a light on these neglected conditions and help to improve provision of safe surgery and anesthesia.[23,24]

In the South African setting, there is no data specifically addressing emergency presentation of hernias. In a retrospective review of surgical admissions in a South African regional hospital, inguinal hernia emergencies contributed 3.7% of all non-trauma surgical emergency, whereas in the elective setting, inguinal hernias accounted for 21% of admissions and incisional hernias 8.6%.[25] Interestingly, incisional hernias did not feature in their list of 15 non-trauma surgical emergencies, indicating the relatively rare nature of incisional hernia complications.[25]

The distribution of surgical services in South Africa is split between private and public health facilities. The public sector, which services the 84% of the population is comprised of primary care clinics and hospitals; district hospital and regional hospital and tertiary hospitals. There still remain huge disparities in terms of access to health between rural and urban areas. Currently the majority of emergency and elective hernia repairs happen at the regional and tertiary health care centers.[26,27] In a study looking at the availability of operative surgery in district hospitals in the Western Cape, only three of the seven district hospitals

offered general surgical services, mostly by visiting specialists. The majority of emergency general surgical conditions such as hernia complications were referred onto regional hospital, a process that could involve a significant time delay between diagnosis and operative management.[28]

Management of Hernia Emergencies

Hernia emergencies are some of the most common conditions that will be managed by the general surgeon. Emergency presentations are associated with 29-36% increase morbidity and seven times fold increase in mortality.[15,28] The principles of management include resuscitation in order to correct life threatening problems, expedited surgical management and performing a durable repair.[4] In the case of bowel obstruction; an attempt at reducing the incarcerated hernia in the emergency department is reasonable, a nasogastric tube is inserted, and intravenous fluids are given with replacement of electrolytes, this then is followed by surgical repair in the same admission.[15] In the case of strangulated hernias, or a suspicion of strangulation; an acutely tender irreducible hernia sometimes with overlying skin erythema; no attempt at reduction should be made, the patient is resuscitated, intravenous antibiotics are administered, and the patient operated urgently.

Surgery is the only effective management strategy for hernias. The optimal time for surgical intervention is related to the form of presentations. In asymptomatic patients, a large prospective randomized trial comprising of 5720 participants with minimally symptomatic inguinal hernias showed that watchful waiting is safe.[12] However, over time more than two thirds of the participants crossed over to surgical repair as symptoms progressed, indicating that hernia disease is progressive.[12]

Operative approach can be either open or laparoscopic, choice of which largely depends on resource and skills availability. A multicenter randomized controlled trial of 1512 participants over a 5 year follow up period, showed that the Total Extra Peritoneal (TEP) approach was comparable to the Lichtenstein open approach. The only drawback was longer operating times, skills availability and increased cost with the TEP approach.[4,29] What remains to be answered is the utility of the laparoscopic approach in the emergency presentation of a groin hernia. Most authors agree that the open approach is still the safest in the emergency setting, although reports suggest that the Transabdominal preperitoneal repair is preferable in the emergency setting. [5,15,30]

The choice of anaesthesia is largely dependent of the patients' co-morbidities and age and the discretion of the on-call anaesthetic. General anaesthesia is adequate for most patients, regional anaesthesia is discouraged in patients with ischaemic heart disease as it can potentiate an ischaemic event.[15] Chen et al found that local infiltration with lidocaine was well tolerated in those patients with were ASA 3 or 4. They found their patients to have better post-operative pain, less urinary complications, shorter recovery and thus reduced costs. The major drawbacks to using Local anesthesia included the pain upon infiltration, inadequate anaesthesia intraoperatively requiring further infiltration and unsatisfactory muscle relaxation.[31]

Another issue in the management of groin hernias relates to the use of mesh. Outside of the Shouldice clinic, the recommended gold standard method is the open Lichtenstein approach. The contention comes in the setting of a clean contaminated or contaminated wound from strangulated hernia requiring bowel resection and anastomosis. Currently the recommended procedure is a tissue repair using the Bassini.[5,15,32] A newer technique named Desarder is not routinely practice in South Africa. The concern with placing mesh in these setting is that it

places the patient at a high risk for mesh infection and the associated complications. Biological or absorbable meshes have been suggested to be used in contaminated settings, but the biological mesh is plagued by unacceptably high cost and equally high reoccurrence rate, some studies quoting up to 30% recurrence rate within 14 months of repair.[4,5,15,33] In a longitudinal, multicenter prospective observational study of 104 patients, evaluating the use of biological mesh in the setting of clean contaminated ventral hernias (The COBRA study), Rosen et al reported 27% wound event rate and 17% hernia reoccur race over a 24 month follow up period. They achieved an 84% follow up rate up 24 months. Hernia reoccurrences were noted to occur more in patients who had wound sepsis post operatively and in those whose biological mesh was place intraperitoneally or as an interposition mesh. However, they still noted that there is a dearth of evidence to support the use of absorbable meshes in groin hernia repairs.[34]

The management of strangulated ventral hernias in clean-contaminated to dirty wounds is plagued by the concern of using mesh in these settings. Hentati et al in their systematic reviews of studies done to answer this question concluded that mesh repair in this setting may be safe but did not recommended the use of mesh because of the current low level of evidence.[15,35]

Complications of hernia repairs in the emergency setting include: surgical site sepsis and mesh sepsis that may require mesh explantation, these affect 1% of repairs;[14] reoccurrence of the hernia; seroma and haematoma formation in the setting of large ventral hernias especially those needing creation of skin flaps and component separation;[14] anastomotic leak in the setting of bowel resection and anastomosis; and urinary retention which affects 6% to 10% of inguinal hernia repairs.[4,15,31] Factors that contribute to increased morbidity and mortality include; ASA class 3 and 4[36], age greater than 65, delays in presentation and time to theatre,[28] and delays in

diagnosis and management and strangulated hernias and short duration of symptoms. [4,5,14,15, 28] This review seeks to elucidate factors associated with emergency hernia presentation and to describe our morbidity and mortality in patients with emergency presentation of hernias to Groote Schuur Hospital.

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Part C:

Publication ready original manuscript

An audit of emergency hernia operations: Surrogate of system failure or incidentalomas.

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Running head: Emergency Hernias

Key words: (acute hernia presentations) OR (emergency hernia presentations) OR (emergency hernia repair)

ABSTRACT

Background:

Hernia emergencies are a common occurrence for the general surgeon and are associated with increased morbidity and mortality. In the South African context, there is currently a dearth of data relating to the emergency management of hernias.

Aim:

An audit of emergency hernia operations to describe outcomes. The secondary aim is to identify system failures that contribute to emergency presentations and sequalae thereof.

Methods:

A retrospective review of prospectively maintained operative reports of emergency hernia operations of all adult patients over a five-year period.

Results:

A total of 998 hernia repairs were performed of which 135 patients were emergencies during the study period. In the emergency cohort 73% of patients were female and the mean age was 58.7 (SD17.6). For 64.4% of patients this emergency presentation was their first contact with surgical service. Mode of presentation was incarcerated for 76% and strangulation for 24%. Of the 14% of patients who was referred from secondary hospitals 83% had established organ failure. Sixty percent of the cohort had comorbidities, the most common being hypertension. On presentation, 27% had organ failure. Thirty-seven percent had a groin hernia, 23% had hernias umbilical hernias, a further 24% had incisional hernias, and 8% had epigastric hernias and 8% had femoral hernias. Sixty-one percent of the hernias were repaired using mesh. Thirty-two percent of the patients had complications, the most common form being a Clavien-Dindo grade 2. Seven patients died and a documented recurrence rate of 5%.

Conclusion:

This study contributes to understanding emergency hernias in South Africa and highlights our lack of clinical follow up. Most of the emergency presentation were de novo. System factors that contributed to hernia emergencies and complications thereof are mostly related to patients with comorbidities that needed optimisation.

Introduction

Hernia surgery is an evolving aspect of general surgery, as other subspecialties branch off and care is centralized, there is a growing interest in hernia surgery and outcomes thereof. Emergency hernia presentations are a common encounter of the general surgeon and are associated with high morbidity and mortality. In the South African context, as in many low to middle income countries, there is currently a lack of literature relating to the emergency management of hernias. The focus on communicable diseases has result in possible neglect of surgical diseases such as hernias, this being evident in the lack of data and poor documentation of surgical diseases.[1] The renewed focus by global surgery initiatives will hopefully shine a light on these neglected conditions and help to improve provision of safe surgery and anesthesia.[2,3]

There is no published data specifically addressing emergency presentation of hernias in South Africa. In a retrospective review of surgical admissions in a South African regional hospital, inguinal hernia emergencies contributed 3.7% of all non-trauma surgical emergency, whereas in the elective setting, inguinal hernias accounted for 21% of admissions and incisional hernias 8.6%.[4]

This audit aims to evaluate all emergency hernia operation in an urban teaching hospital to illicit whether these hernia presentations are incidental or system failures. Secondary aims are to describe the morbidity and mortality in our practice.

Materials and Methods

This is a retrospective audit of a prospectively kept operative records. All patients above the age of 13 who had an emergency hernia operation in the Acute Care Surgery Unit, Groote Schuur Hospital from January 2014 to January 2019 are included in the study and all elective

hernia operations are excluded. We are a tertiary teaching hospital with its own catchment area and also is a referral center for three secondary level hospitals which have little or no high care and intensive care facilities.

Data was captured manually onto an excel spread sheet from patients' folders and electronic operative records. Patients who have presented to a surgical unit with this hernia previously are defined as "Known patients". "New patients" are those with first contact to surgery with this particular problem.

The aim of this study is to investigate whether emergency hernia presentations were incidental or system failures. Secondary aims are to describe the morbidity and mortality in our practice.

Descriptive data collected includes demographics, referral pattern, co-morbidities and risk factors for hernia. Details of previous visits, reason for delay to surgery was collected for the 'known patient' group. The clinical picture on presentation, mode of diagnosis and type of surgery, complications and outcomes were collected.

Data analysis

Categorical data is presented using frequency tables with percentages. Chi-square tests was conducted where appropriate to test for association between categorical variables. Continuous data is summarised in terms of means and standard deviations together with confidence intervals and t-tests for comparison of group means will be used to test for significance.

Results

A total of 998 hernia repairs were performed of which 149 patients were emergencies during the five-year study period. Fourteen patients with inadequate record keeping were excluded and thus 135 patients were analysed. In this emergency cohort 53% of patients were female and the mean age was 58.7 (SD17.6).

Forty-six percent of patients lived in the catchment area of our hospital as depicted in figure 1. However, 86% of patients presented directly to the Groote Schuur Hospital emergency department and the rest were referred from secondary level surgical services in the metropole (Figure 2).

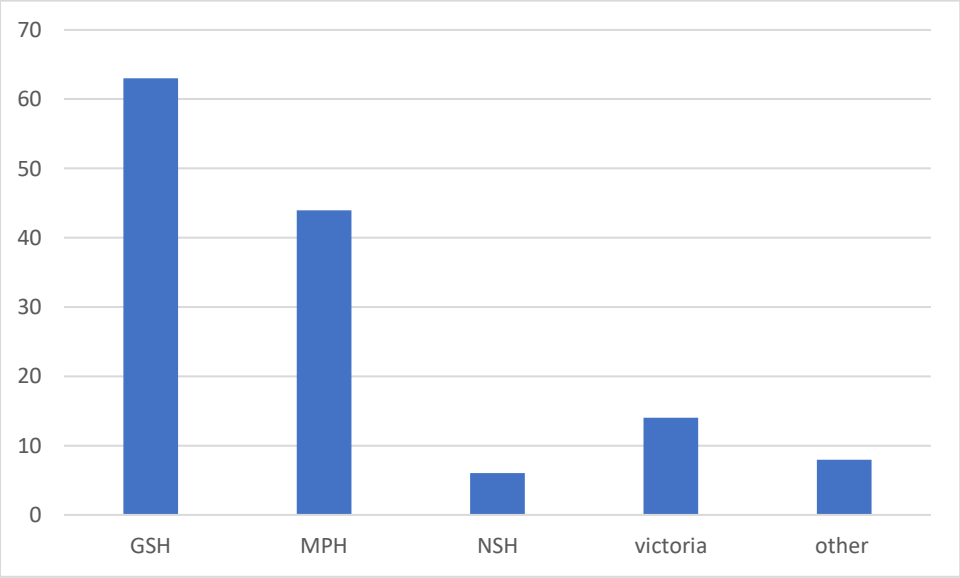

Figure 1 Hospital drainage areas by numbers.

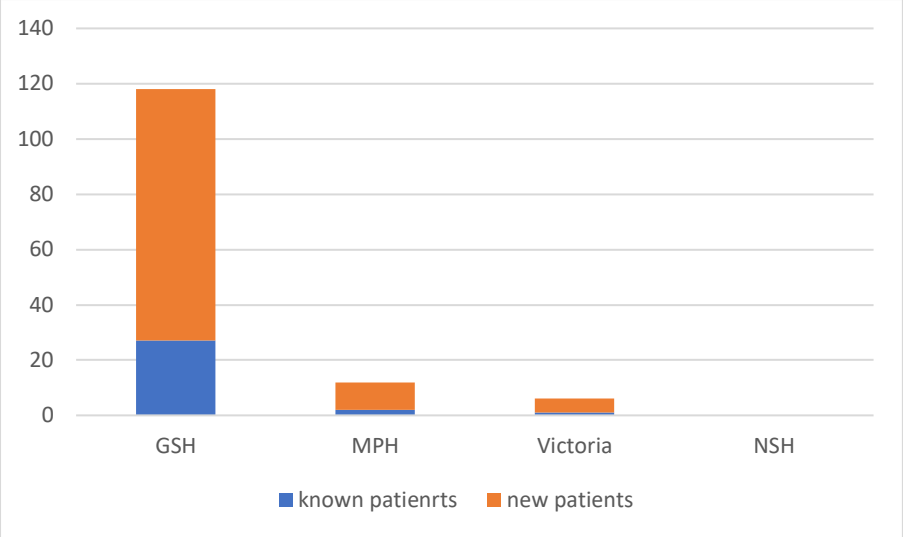

Figure 2 Hospitals the patients presented to.

For 63% of patients, this emergency presentation was their first contact with a surgical service, the other 37% had been seen at least once before. At presentation 76% of the cohort were incarcerated, and 24% were strangulated. The 'new' patient cohort had more strangulated hernias on presentation (17% vs 6%). Inguinal hernias were the most common to present with a complication (38%), followed by umbilical hernias (23%), incisional hernias (23%), epigastric hernias (8%), and femoral hernia (8%) emergency as seen in table 1.

Hernia type	Known	New	Total	p value
Inguinal	15	35	50	
Umbilical	9	23	32	
Incisional	7	24	31	
Epigastric	4	7	11	
Femoral	1	10	11	
Co-morbidities				
smoker	20	32	52	0.63
diabetics	11	14	45	0.43
COPD	10	17	26	0.96
prostatism	8	12	20	0.88
constipation	12	16	28	0.52
hypertension	27	34	61	0.06
IHD	12	9	21	0.03
obesity	20	23	43	0.08
HIV	2	5	7	0.93

Table 1 Distribution of hernias and Co-morbidities between new and known patients.

The most prevalent modifiable risk factor was smoking (36%), followed by subjective obesity at 30%. The most common co-morbid disease was hypertension (44%) and 17% of the patients were diabetic. Thirty-three patients were offered a HIV test, of those 5% testing positive. In the ‘known’ group 12 patients had ischemic heart disease versus 9 in the ‘new’ patient group. This was statistically significant (p 0.03) as shown in table 1. The secondary hospital referral group had more co-morbid diseases (88% versus 46%) and organ failure (83% versus 12%) and this subgroup had more complications (72% versus 21%) and five deaths compared to those who presented directly to our emergency department.

Delay to surgery for the 37% known to surgery were mostly related to system factors: awaiting pre-operative optimization for obesity (n = 4), smoking (n = 2), complication while awaiting elective date (n = 3) and postponed due to overbooked list (n = 1). The only patient related factor involved the six patients who defaulted on their elective surgery booking. Twenty-three of our patients required imaging in order to confirm the diagnosis of a hernia or to quantify size and allow for operative planning.

Sixty three percent of patient presented within 3 days of the commencement of their symptoms, 15% had symptom duration of 4 to 6 days and a further 22% had symptom duration of more than 6 days as seen in figure 3.

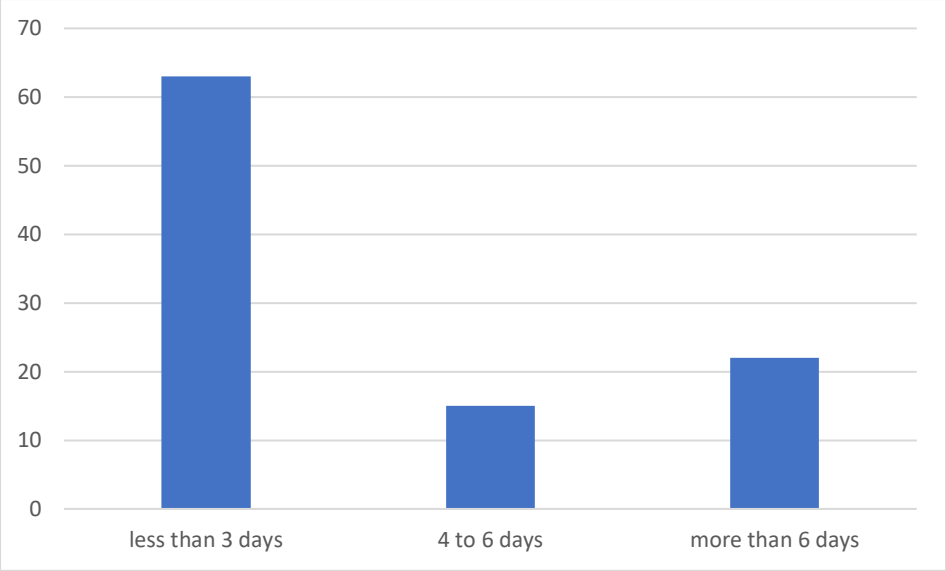

Figure 3 Duration of symptoms

These emergency hernias were triaged for theater as follows: orange 21% (to be done within 2 hours) yellow (to be done within 6 hours) 73% and the rest as green (to be done within 24 hours). The mean time to theatre from presentation was 21 hours. Twenty-nine percent of patients were in theatre within 6 hours of presentation and 27% between 6-12 hours, 23% of patients making it to theatre between 12 and 24 hours and 12% make it to theatre after 48 hours.

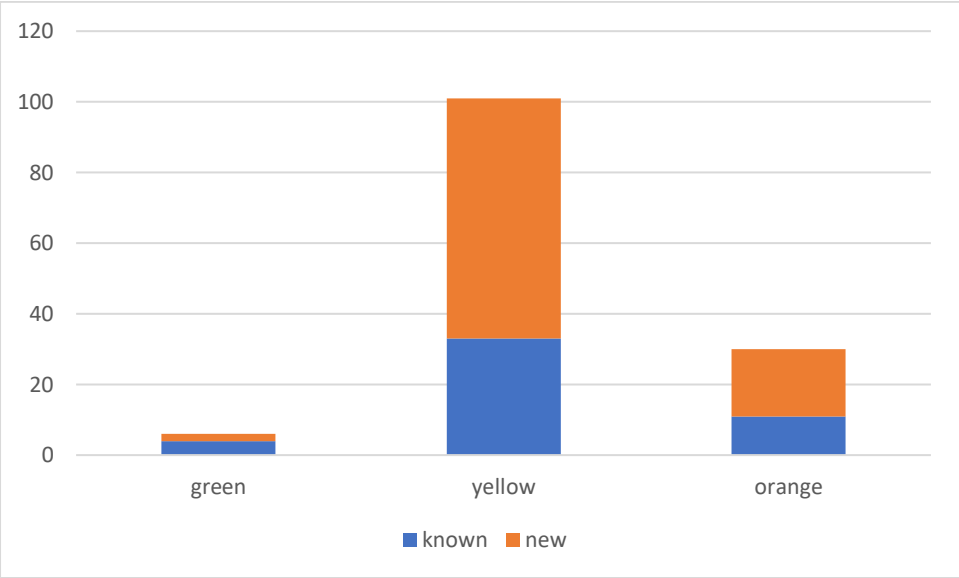

Figure 4 Emergency colour booking

Comparing the ‘new’ and ‘known’ patients, the mean time from first contact to surgery for the new patient cohort was 12.3 hours (SD 15.9) and in the known patient cohort was 38.6 hours (SD 53.9) and this was statistically significant (p = 0.001).

The operative approach was conventional open surgery in all cases. General anesthesia was possible for 98% and three operations were performed under regional anaesthesia. The mean operative time was 89 minutes (SD 49.5) for all patients.

The hernia defect was repaired with sutures in 39% of patients. The reasons stated for suture only repair are as follows: 29 patients required bowel resection and anastomosis or stoma; 24 patients had umbilical hernias with preperitoneal fat or omental contents with a noted size of less than 3 cm; and one patient with an inguinal hernia had a concomitant bladder repair. Mesh was used in 61% of patients. Refer to table 2 for wound classification.

Wound classification	Known	New	Total
clean	41	68	108
clean-contaminated	1	6	7
contaminated	5	8	14
unclassified			7
Complications			
CD2	11	21	32
CD3	2	4	6
CD4	0	3	3
CD5	2	6	8

Table 3 Wound classification and complication as per Clavien-Dindo Classification

The mean length of stay was 7.6 days (SD 20.5). Only 8 patients were admitted for longer than 14 days. Within the first 30 post-operative days, 37% of our patients had complications. The majority of patients (22%) had minor complications that could be treated with medication such as antibiotics, classified as Clavien-Dindo grade 2. Of note, minor complications that altered

the postoperative course but did not require intervention (Clavien-Dindo 1) were not accurately documented in the patient records. Three percent required surgical intervention (Clavien-Dindo 3) and 2% were classified as Clavien-Dindo 4, requiring organ support. Sixteen patients had late complications, those occurring after 30 days of initial operation. There were 15 patients who had minor complications requiring only medication, with one developing an enterocutaneous fistula. Table 4 depicts the range of complications.

Our case series noted 10 deaths in patients who had hernia repairs, only seven of these patients could be analysed as there were three missing records. One had a femoral hernia repair, three had incisional hernia repairs, two had epigastric hernia repairs and one had an umbilical hernia repair. One patient died from respiratory failure, five died from overwhelming sepsis and one patient died following a seizure.

Throughout the study period, were could only document seven hernia reoccurrences (5%) over a follow up period of one year.

Discussion

This will be the first published review of emergency hernias in a South African health care setting. The system factors we could identify to explain delays in patients we knew to have hernias include postponement to optimize modifiable risk factors such as diabetes, obesity and smoking. Some patients fell off an overbooked elective list and three patients presented with a complication whilst waiting for their elective date. Contrary to our belief, elective waiting times and system factors did not account for the majority of emergency hernia presentations.

There is a place for watchful waiting in asymptomatic groin and incisional hernias, especially in those patients with severe comorbidities,[5,6] the caveat here is that when a hernia complication arises, repair is often difficult.

Patient factors that contributed to the majority of emergency presentations were delays due to comorbidities and patient compliance. In our series, 64% of our patients were from our catchment areas. Of interest, 86% of the patients we managed presented directly to our emergency department, suggesting that a large number of patients bypassed the referral pathway. This could have negatively impacted on their time from contact to theatre as our emergency department would have had to deal with an extra load of patients from other catchment areas. Only 18 (13%) patients were referred from secondary level hospitals; 16 of whom had severe comorbidities and thus referred for anesthetic concerns. Fifteen of these patients had organ failure on presentation, 13 of them suffered a complication and five died within the same admission. This illustrates that patients who were referred from secondary level hospitals were indeed physiologically more compromised with worse outcomes.

The total number of patients who died after their hernia repair is seven, with an operative mortality rate of 5%. Although it is similar to that reported by Dai et al in an emergency series, Mehta et al published a much lower mortality rate of 1.3%.[7,8,]

As these patients presented as emergencies, there would have been no time to optimize their comorbidities, and this could be a potential confounder to their increased morbidity. In a study reporting on emergency hernia presentation to the emergency department, Mehta et al found that those who presented with obstruction or strangulation suffered increased morbidity and 67% higher risk of mortality than those who presented with minor symptoms of pain and or a lump.[8] Dai et al estimated an incidence of complications to be between 21-39%.[7]

Even though not directly related to hernia complications, it was interesting to note that the most common comorbid condition was hypertension. Obesity, ischemic heart disease and COPD were the next common comorbidities with an almost equal number between those patients who were known with a hernia and the new presenting patients. This is in keeping with the risk factors as described by Mcdonnell et al.[8,9] Comparing the patients we knew to have hernias to the new patients, we found a statistically significant difference in prevalence of ischaemic heart disease (12 v 9 patients; p 0.03).

Of concern is that none of the patients seen in our outpatient clinic with modifiable risk such as diabetes, COPD, obesity and smoking factors were able to be repaired electively due to persistence of these risk factors; this raises the question of whether the delay was then justified and whether we are doing enough to help these patients improve their premorbid conditions. Spence et al looked at the trends of patients seen with hernias in the emergency department and the factors that lead to their admission or discharge. Patients who smoked or who were obese more likely to have their surgery delayed in order to improve their risk factors.[10] A combined hernia clinic that would offer smoking cessation programs, referral to pulmonary, endocrine, cardiac and bariatric clinic could be useful.

South African population has the highest prevalence of Human Immunodeficiency Virus (HIV) infection with an estimated 13.1% of the population.[11] It was disappointing that only 27% of our patient population were recorded as having had an HIV test, with 5% testing positive. This

is an area that could do with improvement, perhaps it is time we make mandatory HIV testing for all our patients as they would benefit from early antiretroviral treatment.

Our practice might be influenced by surgical anecdote and ambiguous guidelines relating to the use of mesh in the setting of clean-contaminated and contaminated wounds. The operating surgeon will often choose what he or she determines to be the safest course.[12,13] An intraperitoneal biological was inserted in one patient with a wound noted to be contaminated by murky fluid and edematous bowel in the sac. This patient had a large defect with multiple pockets which made approximation of the fascial layers, even after component separation difficult had. According to the COBRA trial, intraperitoneal placement of a biologic was one of the factors that was associated with a higher reoccurrence rate. In their study, their overall reoccurrence rate at two years was 17%.[14]

Majority of our patients had general anaesthesia, with only 3 having regional anaesthesia. None of our patients had their operations under local anaesthesia. This is probably related to the undesirable nature of repeated local infiltration. It is important to note that local anaesthesia as opposed to regional may play a role in patients who are ASA 3 or 4, especially those with severe COPD and ischemic heart disease.[15] It can potentially allow them to be operated as outpatients, but this in an elective setting.[16] Regional anaesthesia can potentiate a myocardial infarction in these patients.[17] A retrospective review of anaesthestic techniques in Ghana suggested that local anaesthesia is underutilized in their elderly patients and those with comorbidities.[2]

An encouraging result is that 71% of the patients that presented to the emergency department had no organ failure and thus could wait to get to theatre via the busy emergency booking list. Our overall complication rate for all hernias we managed was 13% which is lower than that reported by Davies et al at 46%.[3] When breaking it down into the type of hernias: we had an inpatient morbidity rate for emergency inguinal hernia repairs of 36%, the majority of whom had wound sepsis, which is in keeping with that reported by Dai et al at 21-39%.[4] For incisional hernias, we report a morbidity rate of 53% with three mortalities in the 30 patients managed.

We could not adequately describe our 30 day follow up as we have no system in place, which means there could be a significant number of missed complications. The same concern goes for our mortality rate. We are aware of the three patients who died at home for unclear reasons and another three who also died were not included in this analysis because their files could not be located. Post op mortality is quoted to be seven times higher in the those who present with emergencies compared to elective admissions and it increases to by a factor of 30 in those requiring bowel resection.[16]

Clearly there is a need for a hernia registry as an attempt to understand to the burden of disease and hernia outcomes in Africa, to assist in formulating guidelines that will contribute to modern and safe hernia surgery throughout Africa. Ohene-Yeboah et al in their paper looking at hernia diseases in Africa describe how hernia disease have been neglected in public health programs in Africa.[2]

None of our patients had laparoscopic operations, this is probably related to the fact that in our setting, a lot of these hernia emergency operations occur at night and are performed by junior surgeons. Laparoscopy in the emergency setting has a role as described by Testaldi et al, as diagnostic tool, for example where there has been reduction of questionable hernia contents preoperatively or at induction of anaesthesia, one could perform a hernioscopy or diagnostic laparoscopy to exclude bowel ischaemia.[18] Even though laparoscopy is feasible for the majority of cases, this would still require a stable patient and a competent surgeon.

Major limitations of our study is in its retrospective nature, only one center, and the lack of complete follow up data. A prospectively collected hernia registry will go a long way in addressing these problems.

Conclusion:

This is the first study investigating emergency hernia operations in a South African practice setting. Unfortunately there are limitations with the incomplete follow up and thus potentially provide unreliable data about morbidity and mortality. Majority of emergency hernia patients requiring surgery presented without a prior history. For this reason, we could not identify delaying system factors contributing to emergency presentations. The study hopefully adds to the local understanding of the management pathway of a patient who presents with a hernia emergency.

We could not identify system errors based on this work, so we are careful not to make concrete suggestion which ultimately would be opinions rather than science. This is a retrospective audit of practice so we cannot give surgical recommendations based on this.

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Part D - Supporting documents

Addendum C: Author guidelines of South African Journal of Surgery pg. 53

Addendum D: Departmental Research Committee approval pg. 57

Addendum E: HREC Approval pg. 58

Author guidelines of South African Journal of Surgery

Authorship

Named authors must consent to publication. Authorship should be based on substantial contribution to:

(i) conception, design, analysis and interpretation of data;

(ii) drafting or critical revision for important intellectual content; and

(iii) approval of the version to be published. These conditions must all be met (uniform requirements for manuscripts submitted to biomedical journals; refer to www.icmje.org).

Conflict of interest

Authors must declare all sources of support for the research and any association with a product or subject that may constitute conflict of interest.

Research ethics committee approval

Provide evidence of Research Ethics Committee approval of the research where relevant.

Protection of patient's rights to privacy

Identifying information should not be published in written descriptions, photographs, and pedigrees unless the information is essential for scientific purposes and the patient (or parent or guardian) gives informed written consent for publication. The patient should be shown the manuscript to be published.

Ethnic classification

References to ethnic classification must indicate the rationale for this.

Manuscripts

Shorter items are more likely to be accepted for publication, owing to space constraints and reader preferences.

Original articles not exceeding 3 000 words, with up to 6 tables or illustrations, are usually observations or research of relevance to surgery. References should preferably be limited to no more than 15. Please provide a structured abstract not exceeding 250 words, with the following recommended headings: *Background, Objectives, Methods, Results,* and *Conclusion.*

Manuscript preparation

Refer to articles in recent issues for the presentation of headings and subheadings. If in doubt, refer to 'uniform requirements' - www.icmje.org. Manuscripts must be provided in UK English.

Qualification, affiliation and contact details of ALL authors must be provided in the manuscript and in the online submission process.

Abbreviations should be spelt out when first used and thereafter used consistently, e.g. 'intravenous (IV)' or 'Department of Health (DoH)'.

Scientific measurements must be expressed in SI units except: blood pressure (mmHg) and haemoglobin (g/dl). Litres is denoted with a lowercase 'l' e.g. 'ml' for millilitres). Units should be preceded by a space (except for %), e.g. '40 kg' and '20 cm' but '50%'. Greater/smaller than signs (> and 40 years of age'. The same applies to ± and º, i.e. '35±6' and '19ºC'.

Numbers should be written as grouped per thousand-units, i.e. 4 000, 22 160...

Quotes should be placed in single quotation marks: i.e. The respondent stated: '...'
Round brackets (parentheses) should be used, as opposed to square brackets, which are reserved for denoting concentrations or insertions in direct quotes.

General formatting

The manuscript must be in Microsoft Word or RTF document format. Text must be single-spaced, in 12-point Times New Roman font, and contain no unnecessary formatting (such as text in boxes, with the exception of Tables).

Illustrations and tables

If tables or illustrations submitted have been published elsewhere, the author(s) should provide consent to republication obtained from the copyright holder.

Tables may be embedded in the manuscript file or provided as 'supplementary files'. They must be numbered in Arabic numerals (1,2,3...) and referred to consecutively in the text (e.g. 'Table 1'). Tables should be constructed carefully and simply for intelligible data representation. Unnecessarily complicated tables are strongly discouraged. Tables must be cell-based (i.e. not constructed with text boxes or tabs), and accompanied by a concise title and column headings. Footnotes must be indicated with consecutive use of the following symbols: * † ‡ § ¶ || then ** †† ‡‡ etc.

Figures must be numbered in Arabic numerals and referred to in the text e.g. '(Fig. 1)'. Figure legends: Fig. 1. 'Title...' All illustrations/figures/graphs must be of high resolution/quality: 300 dpi or more is preferable but images must not be resized to increase resolution. Unformatted and uncompressed images must be attached as 'supplementary fil**es**' upon submission (not embedded in the accompanying manuscript). TIFF and PNG formats are preferable; JPEG and PDF formats are accepted, but authors must be wary of image compression. Illustrations and graphs prepared in Microsoft Powerpoint or Excel must be accompanied by the original workbook.

References

Authors must verify references from the original sources. *Only complete, correctly formatted reference lists will be accepted.* Reference lists must be generated manually and **not** with the use of reference manager software. Citations should be inserted in the text as superscript numbers between square brackets, e.g. These regulations are endorsed by the World Health Organization,[2] and others.[3,4-6] All references should be listed at the end of the article in numerical order of appearance in the Vancouver style (not alphabetical order). Approved abbreviations of journal titles must be used; see the List of Journals in Index Medicus. Names and initials of all authors should be given; if there are more than six authors, the first three names should be given followed by et al. First and last page, volume and issue numbers should be given. Wherever possible, references must be accompanied by a digital object identifier (DOI) link and PubMed ID (PMID)/PubMed Central ID (PMCID). Authors are encouraged to use the DOI lookup service offered by CrossRef.

Journal references: Price NC, Jacobs NN, Roberts DA, et al. Importance of asking about glaucoma. Stat Med 1998;289(1):350-355. [http://dx.doi.org/10.1000/hgjr.182] [PMID: 2764753]

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Other references (e.g. reports) should follow the same format: Author(s). Title. Publisher place: publisher name, year; pages. Cited manuscripts that have been accepted but not yet published can be included as references followed by '(in press)'. Unpublished observations and personal communications in the text must not appear in the reference list. The full name of the source person must be provided for personal communications e.g. '...(Prof. Michael Jones, personal communication)'.

Proofs

A PDF proof of an article may be sent to the corresponding author before publication to resolve remaining queries. At that stage, only typographical changes are permitted; the corresponding author is required, having conferred with his/her co-authors, to reply within 2 working days in order for the article to be published in the issue for which it has been scheduled.

UNIVERSITY OF CAPE TOWN

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20 Nov 2018

Dr b Nkgudi

Department of Surgery
University of Cape Town

Dear Dr Nkgudi

RE: Project 2018/151

PROJECT TITLE: Emergency Hernias: Surrogate Of Failure Or Incidentiloma's?

The above protocol has been reviewed by the Department of Surgery Research Committee. I am pleased to inform you that the committee approved the scientific merit of the study, and endorse the protocol for submission to the relevant ethics committee.

Although this letter serves as confirmation that the above protocol has successfully passed through the surgical DRC, respective ethics committees still require DRC chair signature before submission.

Please use the above project number in all future correspondence,

Yours sincerely

DR TIMOTHY PENNEL
CHAIRMAN: RESEARCH COMMITTEE

"OUR MISSION is to be an outstanding teaching and research university, educating for life and addressing the challenges facing our society."

Addendum E: Faculty Ethics Committee approval

UNIVERSITY OF CAPE TOWN
Faculty of Health Sciences
Human Research Ethics Committee

Room E53-46 Old Main Building
Groote Schuur Hospital
Observatory 7925
Telephone [021] 406 6492
Email: sumayah.ariefdien@uct.ac.za
Website: www.health.uct.ac.za/fhs/research/humanethics/forms

09 July 2019

HREC REF: 452/2019

Dr C Kloppers
HPB and Surgical Gastroenterology
Department of General Surgery
J-Floor, OMB

Dear Dr Kloppers

PROJECT TITLE: EMERGENCY HERNIAS: SURROGATE OF FAILURE OR INCIDENTILOMA'S? (MMED CANDIDATE - B NKGUDI)

Thank you for submitting your study to the Faculty of Health Sciences Human Research Ethics Committee (HREC) for review.

It is a pleasure to inform you that the HREC has **formally approved** the above-mentioned study.

Approval is granted for one year until the 30 July 2020.

Please submit a progress form, using the standardised Annual Report Form if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.
(Forms can be found on our website: www.health.uct.ac.za/fhs/research/humanethics/forms)

We acknowledge that the student: - Boitumelo Nkgudi will also be involved in this study.

Please quote the HREC REF in all your correspondence.

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please note that for all studies approved by the HREC, the principal investigator **must** obtain appropriate institutional approval, where necessary, before the research may occur.

Yours sincerely

PROFESSOR M BLOCKMAN
CHAIRPERSON, FHS HUMAN RESEARCH ETHICS COMMITTEE

Federal Wide Assurance Number: FWA00001637.
Institutional Review Board (IRB) number: IRB00001938
NHREC-registration number: REC-210208-007