A DISSERTATION ON

"A PROSPECTIVE STUDY ON COMBINATION OF RAISED SERUM C-REACTIVE PROTEIN AND D – LACTATE AS USEFUL BIOMARKERS IN PREDICTION OF BOWEL GANGRENE IN INTESTINAL OBSTRUCTION"

Submitted to

THE TAMIL NADU DR.MGR MEDICAL UNIVERSITY

CHENNAI – 600032

In partial fulfillment of the regulations For the awards of the degree of

M.S. DEGREE - GENERAL SURGERY BRANCH – I

GOVERNMENT MOHAN KUMARAMANGALAM

MEDICAL COLLEGE,

SALEM

MAY 2020

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Introduction

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ABSTRACT

INTRODUCTION:

Intestinal obstruction is one of the commonest clinical problems in surgical practice. One of grave complication of intestinal obstruction is Strangulation requiring Resection & Anastomosis of involved bowel. Bowel ischemia occurs in 7 – 42 % of bowel obstruction. Bowel ischemia significantly increases mortality associated with bowel obstruction. TIME is an essence. Earlier diagnosis of strangulation favours increased patient survival rate. Diagnosis of strangulation is primarily clinical. Only few studies in human have been reported regarding the biomarkers of preoperative strangulation.

AIM OF STUDY:

To study on combination of raised serum c-reactive protein and d – lactate as useful biomarkers in prediction of bowel gangrene in intestinal obstruction

MATERIALS AND METHODS:

Cases admitted to GMKMC hospital Salem with signs of intestinal obstruction in Emergency ward will be closely monitored from the day of admission to the day of discharge. On an average of 100 patients with signs of intestinal obstruction and strangulation admitted in emergency ward between 2017-2019.

OBSERVATION:

A Prospective Study on Combination of Raised Serum C - reactive protein and D – Lactate as Useful Biomarkers in Prediction of Bowel Gangrene in Intestinal Obstruction included 100 patients presenting with signs of intestinal obstruction and strangulation. All patients presenting with acute intestinal obstruction of were selected, serum CRP & D-lactate were taken pre operatively and their increase were correlated with per operative findings of bowel gangrene.

The age distribution of the patients is given below. The mean age is 51.13 years with a standard deviation of 12.2 years. The majority of the patients were males (n=53, 53%) and the rest were females (n=47, 47%).Abdominal pain was seen in fifty patients (50%) and the rest did not have abdominal pain (n=80, 80%). Irreducible swelling was present in 40% (n=40) of the patients while the remaining (n=60, 60%) did not have irreducible swelling.

The incidence of vomiting in patients was 52% (n=52) while 48% of them (n=48) did not have vomiting. Around 45% (n=45) cases presented with obstipation while the rest did not have obstipation. Abdominal distension was present in 48% (n=48) of the cases while the remaining 52% (n=52) did not have abdominal distension. Guarding was present in 60% (n=60) of the cases while the rest (n=40, 40%) did not have guarding or rigidity.

The patients presenting with bowel sounds were 35% (n=35) while the rest (n=65, 65%) did not have bowel sounds. Majority of them had symptoms for more than 48 hours (n=62, 62%). Around 22% (n=22) of them had symptoms between 24-48 hours while the rest (n=16, 16%) had symptoms for less than 24 hours. Around 81% (n=81) did not have any history of previous surgery. The gangrene of the bowel was present in 31% (n=31) of the cases while the rest were normal (n=56, 56%) or pregangrenous state (n=13, 13%).

The mean serum LDH was high (mean=869, S.D=192) and serum CRP was high (mean=126, S.D=29.87) in patients with gangrene.

The serum LDH and Serum CRP are useful Biomarkers in Prediction of Bowel Gangrene in Intestinal Obstruction.

CONCLUSION:

Strangulation is the gravest outcome of the illness that might require an emergency procedure. Time is golden in the management of acute intestinal strangulation. Earlier is the diagnosis and intervention, better is the prognosis. The diagnosis of strangulation depends on the clinical evaluation and the expertise of the team evaluating the patient. The serum LDH and Serum CRP are useful Biomarkers in Prediction of Bowel Gangrene in Intestinal Obstruction.

KEYWORDS: INTESTINAL OBSTRUCTION**,** BOWEL GANGRENE, CRP, LACTATE DEHYDROGENASE

INTRODUCTION

INTRODUCTION

One of the commonest problems clinically encountered in surgical practice is intestinal obstruction[1,2]. It is defined as the "functional or mechanical interruption of the normal passage of contents through the gastrointestinal tract". The obstruction may be due to reasons either within the wall or outside the wall or in the lumen. It may be either partial or complete. The characteristic sequelae is the accumulation of gas and air in the intestine leading to the swelling of the bowel wall. This culminates in the collection of fluid in the lumen thereby stretching the intestinal wall and jeopardise the perfusion of the wall. The functional obstruction may be due to the dysfunction of the splanchnic nerve. It can be either in the small intestine or the large intestine. In the small intestine, where it is more common, it is known as SBO (Small Bowel Obstruction).

Mechanical obstruction can be classified in various ways[3];

Based on the location of the etiology in the bowel wall, it can be:

a) Luminal

- when the obstruction causing agent within the bowel lumen

b) Mural

- when the obstruction causing agent within the bowel wall

c) Extramural

- when the obstruction causing agent outside the bowel wall

Based on the location on the length of the bowel, it can be

a) Proximal (When the site of the obstruction is high)
b) Distal (when the site of obstruction is low)

Based on the communication with the rest of the lumen of the bowel, it can be;

a) Closed Loop

- In closed loop obstruction, there are two points of occlusion in the lumen of the intestine leading to disconnection between the obstructed part and the rest of the bowel. There are no prograde or retrograde movement of the contents of the bowel.

b) Open-ended

- In open-ended obstruction, there is only one point of occlusion in the lumen of the intestine leading to disconnection between the obstructed part and only one side of the bowel. There is either prograde or retrograde movement of the contents of the bowel.

Based on the completeness of the obstruction of the bowel, it can be classified as;

a) Partial

Some contents like liquid and gas may pass from the site of obstruction to the other side

b) Complete

No content can pass from the site of obstruction to the other side

Based on the severity and prognosis, it can be;

a) Simple

- it is simple when there is no residual or resultant sequelae, resolves easily and has good prognosis

b) Complicated

- It is complicated when there are sequelae like ischemia, infarction and perforation. This is due to the loss of blood flow to the parts of the bowel due to the circulation compromise.

One of the commonest surgical emergency in abdominal surgery is acute mechanical bowel obstruction[4,5]. It is associated with increased morbidity and economic burden to hospitals globally[6]. It is a major reason for admission in the surgical ICU and emergency[7]. Intestinal obstruction is a serious condition that requires rapid identification, diagnosis and treatment[8,9]. One of the challenges of acute bowel obstruction is the inability to differentiate between simple and complicated acute intestinal obstruction. This is essential to decide if an emergency surgery is required or non-operative procedures are enough[10,11].

The decision for the management of acute intestinal obstruction should be made based on the various clinical, laboratory and radiological parameters[12]. Even

experienced clinicians with good laboratory and radiological procedures find it challenging to decide the mode of management of acute intestinal obstruction[13-15].

Immediate and accurate diagnosis of the obstruction along with the etiology is essential for effective management and good prognosis[16-20]. The clinical picture[21-23], etiology[24-29], prevalence of strangulation[30-32] are not conclusive leading to inconclusive standard method of care[33-39].

Strangulation is the gravest outcome of the illness that might require an emergency procedure. Emergency laparotomy being the treatment of choice. Around 7 to 42% of the intestinal obstructions are faced with the complications of strangulation[40].

Time is golden in the management of acute intestinal strangulation. Earlier is the diagnosis and intervention, better is the prognosis. The diagnosis of strangulation depends on the clinical evaluation and the expertise of the team evaluating the patient.

The clinical features include;

a) *Sudden onset of pain that is continuous in nature*
b) *Early appearance of shock*
c) *Fever*
d) *Tachycardia*

e) Marked Abdominal Tenderness

f) Guarding of abdomen

g) Tender abdominal mass

i) Rebound tenderness

Role of biochemical markers[41-64]

The role of various biochemical markers have been explored and studied to find out if any of them may indicate an intestinal obstruction and be used as an effective and reliable indicator. Some of the markers studied include;

1. serum tumor necrosis factor α
2. C-reactive protein (CRP)
3. interleukin 6
4. D-lactate
5. D-dimer
6. alpha glutathione S-transferase
7. intestinal fatty acid binding protein (I-FABP)
8. creatine kinase B
9. iso enzymes of lactate dehydrogenase
10. procalcitonin
11. alkaline liver phosphatase
12. urinary phosphate

But all of them have been studied in animal models with few exceptions of human tissue studies and patients. Still, a vast majority of the literature is incapable of supporting any hypothesis of using these biomarkers leaving a gap in literature.

C-Reactive Protein

- This is found in blood, the levels of which is positively correlated with inflammation. CRP is an acute-phase protein that is manufactured in the liver in response to the pro inflammatory factors released by adipocytes[65].
- It belongs to a family of proteins called Pentraxin
- The levels of CRP are elevated in;
    a) Inflammation
    b) Infection
    c) Trauma
    d) Tissue Necrosis
    e) Malignancies
    f) Autoimmune disorders

Lactic Acid

- When glucose is broken down in the tissues, Lactic Acid is found as an end product.
- It exists in two optical isomer forms namely; L-lactate and D-lactate.
- D-Lactate form is not found in the human body in normal conditions.
- But when there are acute injuries to the intestinal mucosa, there is an abnormal multiplication of the bacterial flora of the intestine due to the ischemia of the mesentric arteries[66-68].

Need for Study

Therefore, this study was aimed at understanding the combination of raised serum C-Reactive Protein and D – Lactate as useful biomarkers in prediction of bowel gangrene in intestinal obstruction.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Etiology and Classification

One of the commonest problems clinically encountered in surgical practice is intestinal obstruction[1,2]. In around 75% of the patients, previous surgeries for adhesive bands, external hernias or internal hernias causes intestinal obstruction. In these patients, 5-25% of them get readmitted within first few weeks of the surgery, of which, 10-50% of them would have surgical intervention. Laparoscopic surgeries may help in lowering the incidence of post-operative complications and subsequent adhesions than open surgeries. One exception is the laparoscopic gastric bypass procedures that have high number of complications and require post-operative complications. The reason for this complication is not known.

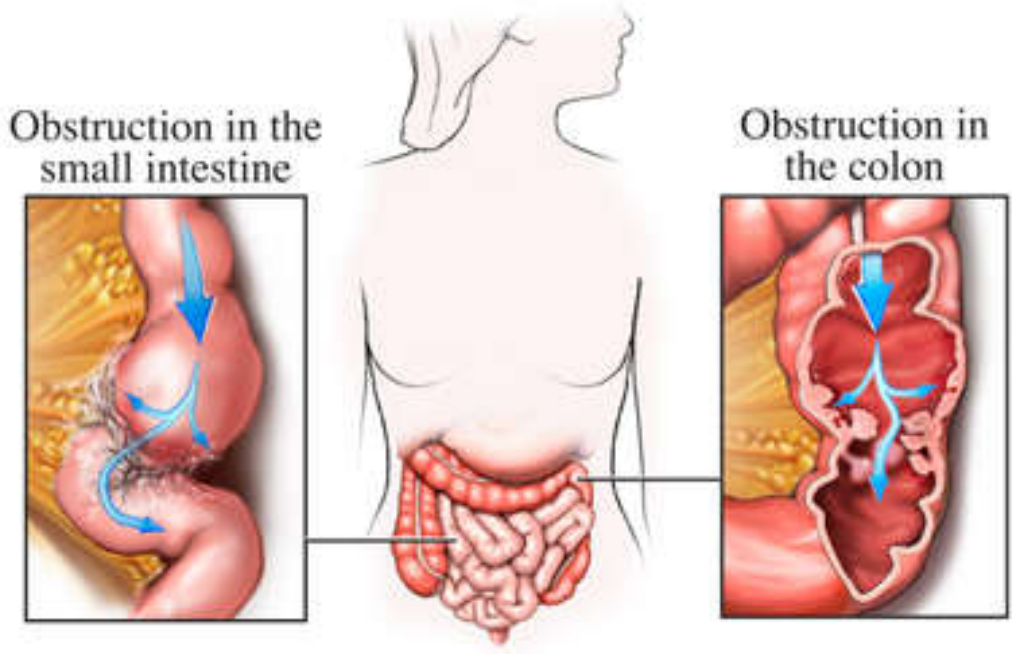


Image 1: Acute Intestinal Obstruction

It is defined as the "functional or mechanical interruption of the normal passage of contents through the gastrointestinal tract". The obstruction may be due to reasons either within the wall or outside the wall or in the lumen. It may be either partial or complete. The characteristic sequelae is the accumulation of gas and air in the intestine leading to the swelling of the bowel wall. This culminates in the collection of fluid in the lumen thereby stretching the intestinal wall and jeopardise the perfusion of the wall. The functional obstruction may be due to the dysfunction of the splanchnic nerve. It can be either in the small intestine or the large intestine. In the small intestine, where it is more common, it is known as SBO (Small Bowel Obstruction).

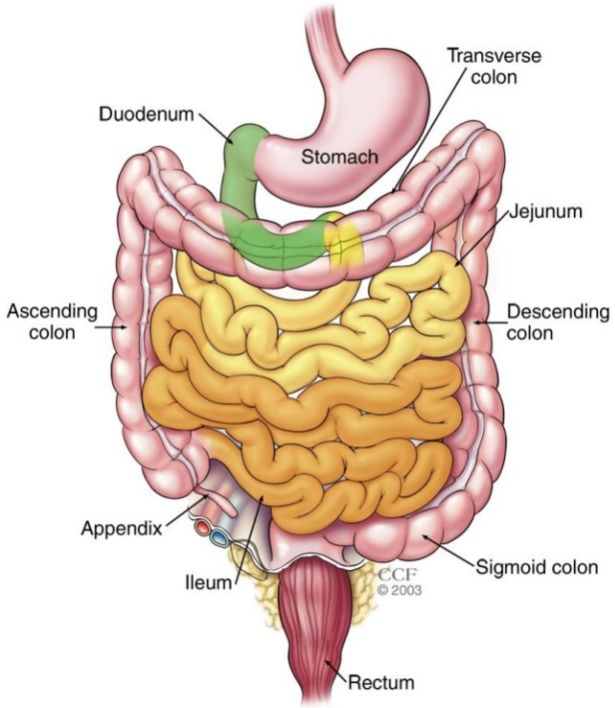


Image 2: Small Bowel Obstruction

Mechanical obstruction can be classified in various ways[3];

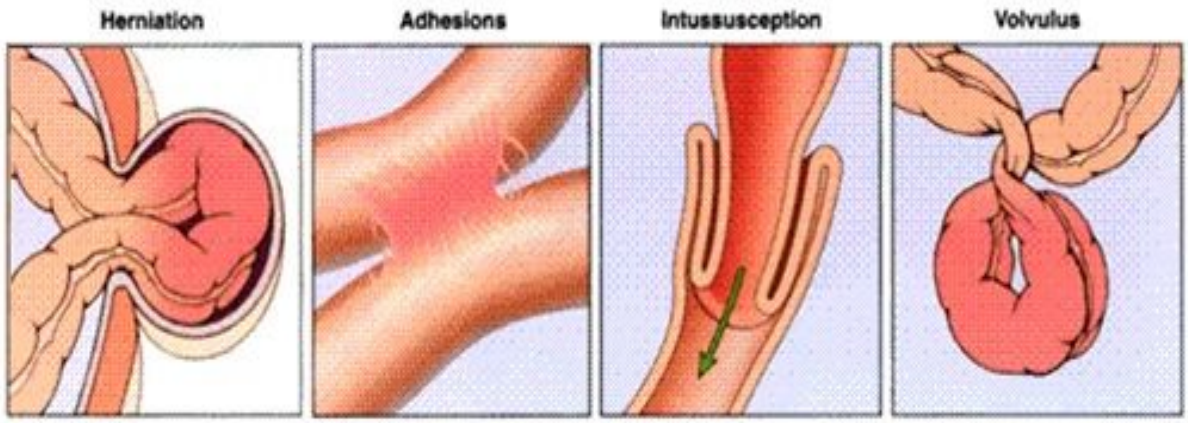


Image 3: Etiology of Mechanical Obstruction

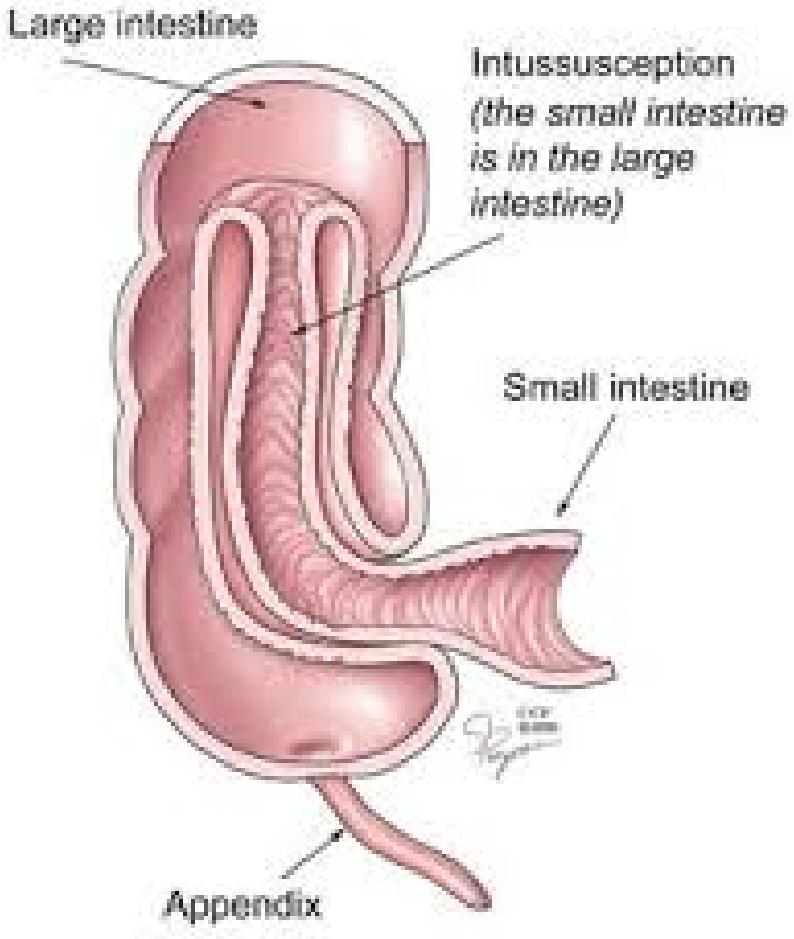


Image 4: Intussusception

Based on the location of the etiology in the bowel wall, it can be:

a) Luminal

- when the obstruction causing agent within the bowel lumen

b) Mural

- when the obstruction causing agent within the bowel wall

c) Extramural

- when the obstruction causing agent outside the bowel wall

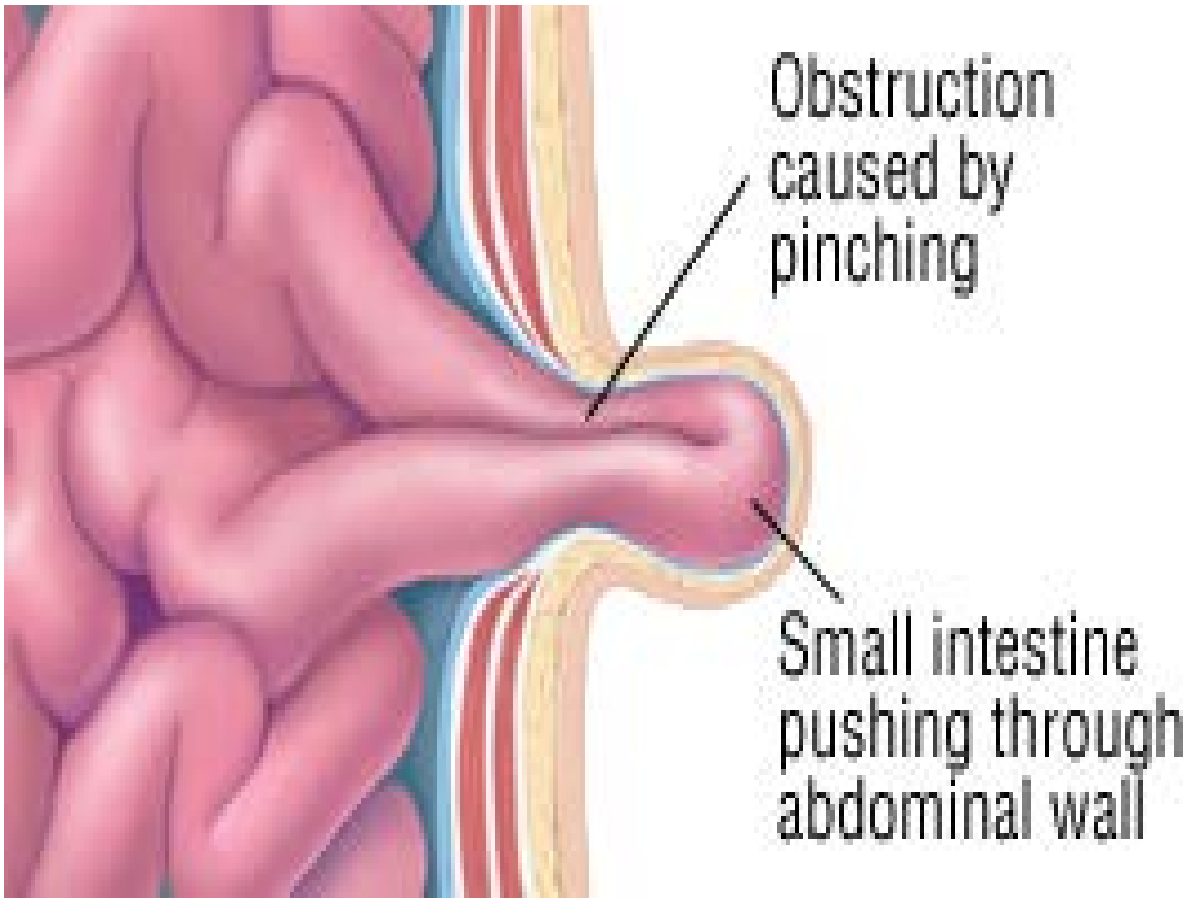


Image 5: Extramural Obstruction

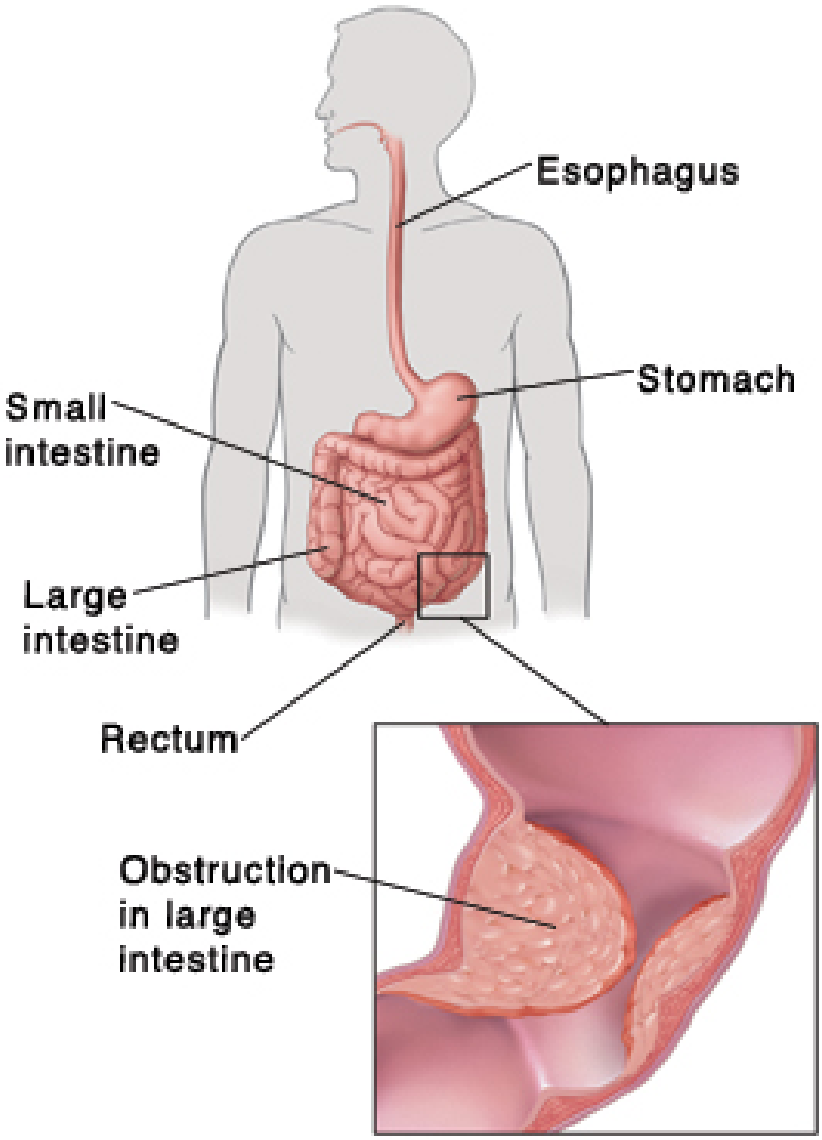


Image 6: Intramural Obstruction

Based on the location on the length of the bowel, it can be

a) Proximal (When the site of the obstruction is high)

b) Distal (when the site of obstruction is low)

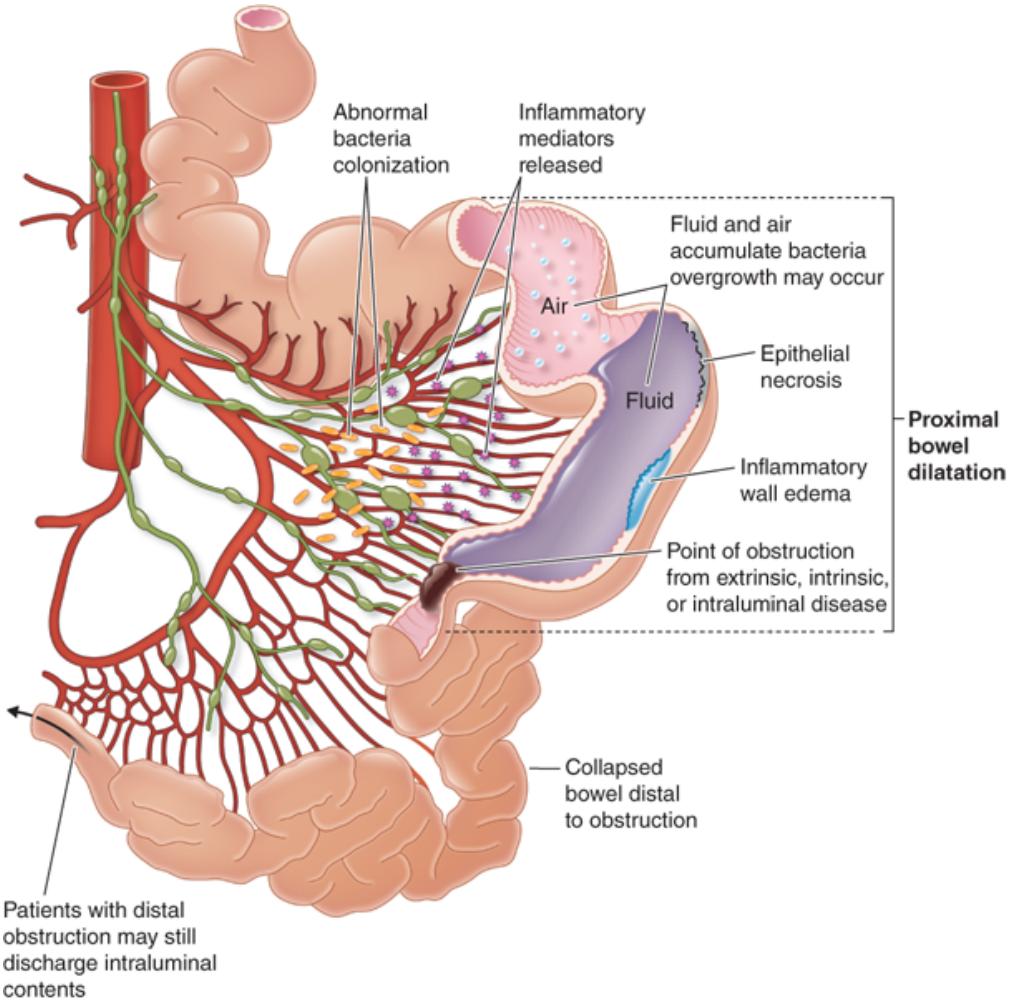


Image 7: Proximal and Distal Obstruction

Based on the communication with the rest of the lumen of the bowel, it can be;

a) Closed Loop

- In closed loop obstruction, there are two points of occlusion in the lumen of the intestine leading to disconnection between the obstructed part and the rest of the bowel. There are no prograde or retrograde movement of the contents of the bowel.

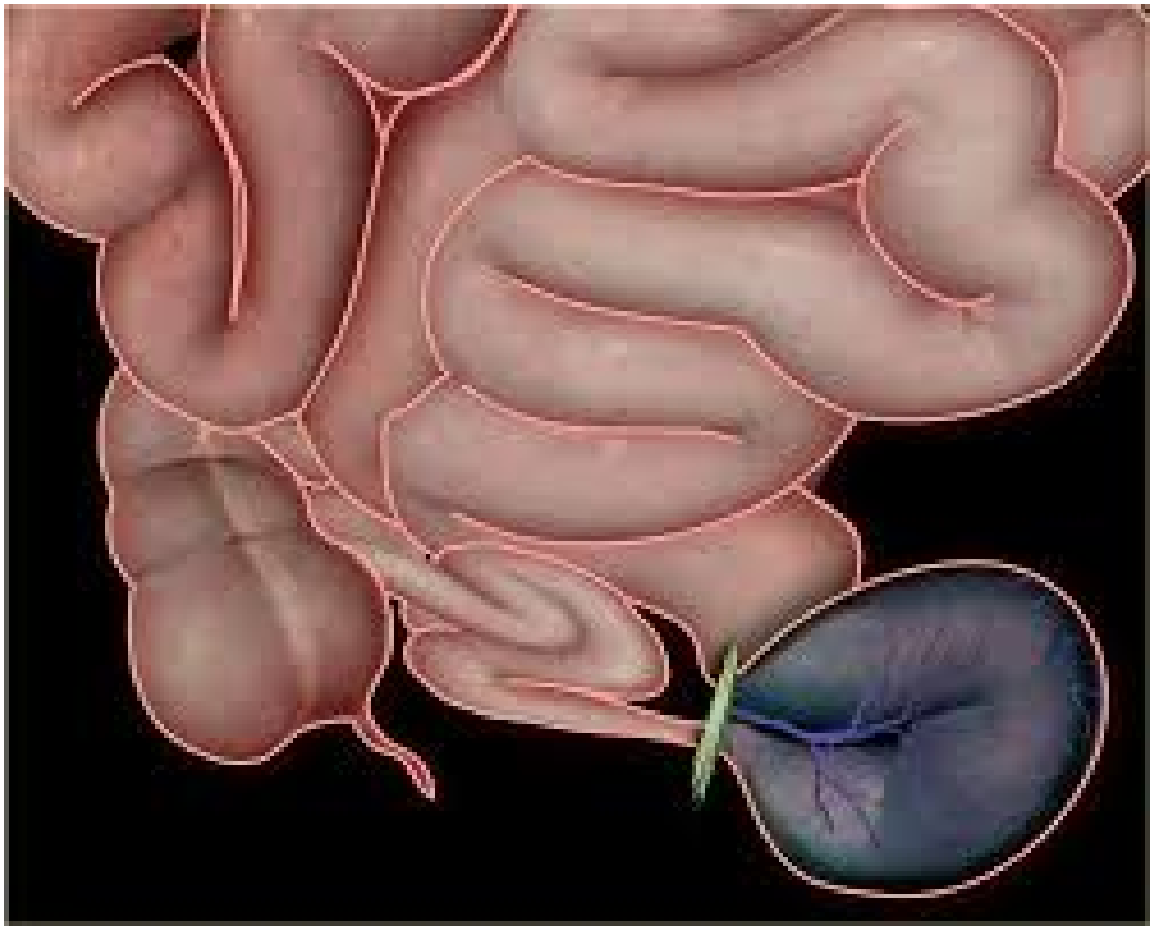


Image 8 : Closed Loop Obstruction

b) Open-ended

- In open-ended obstruction, there is only one point of occlusion in the lumen of the intestine leading to disconnection between the obstructed part and only one side of the bowel. There is either prograde or retrograde movement of the contents of the bowel.

Based on the completeness of the obstruction of the bowel, it can be classified as;

a) Partial

Some contents like liquid and gas may pass from the site of obstruction to the other side

b) Complete

No content can pass from the site of obstruction to the other side

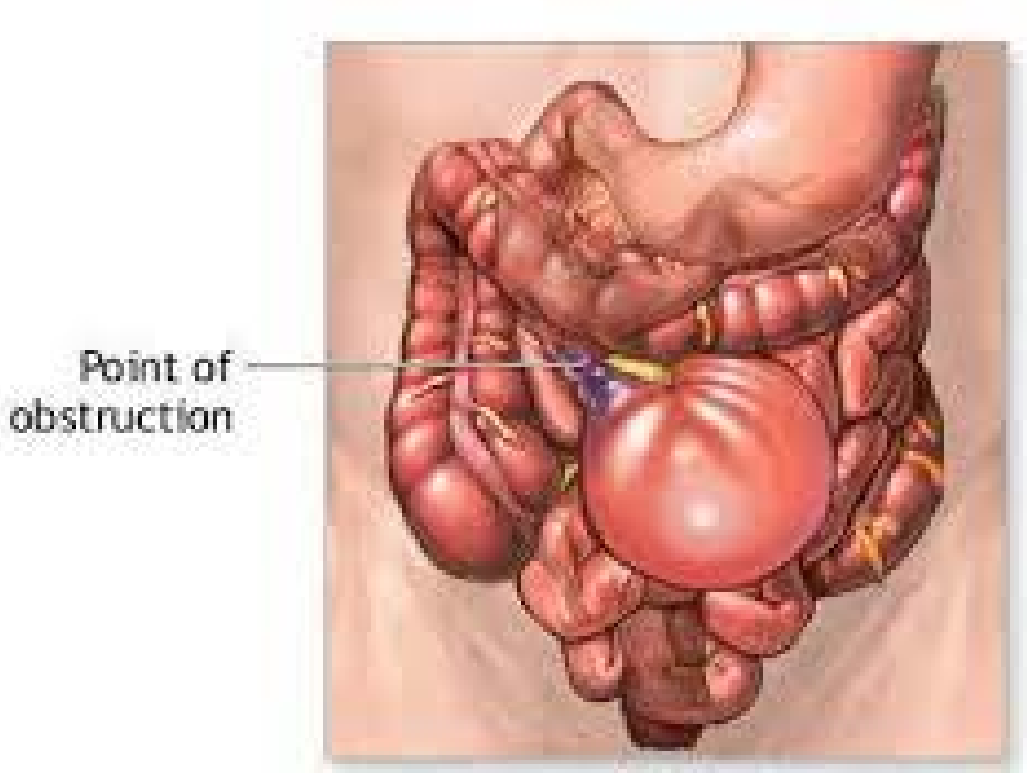


Image 9: Complete of Obstruction

Based on the severity and prognosis, it can be;

a) Simple

- it is simple when there is no residual or resultant sequelae, resolves easily and has good prognosis

b) Complicated

- It is complicated when there are sequelae like ischemia, infarction and perforation. This is due to the loss of blood flow to the parts of the bowel due to the circulation compromise.

The following image shows the most common causes of intestinal obstruction

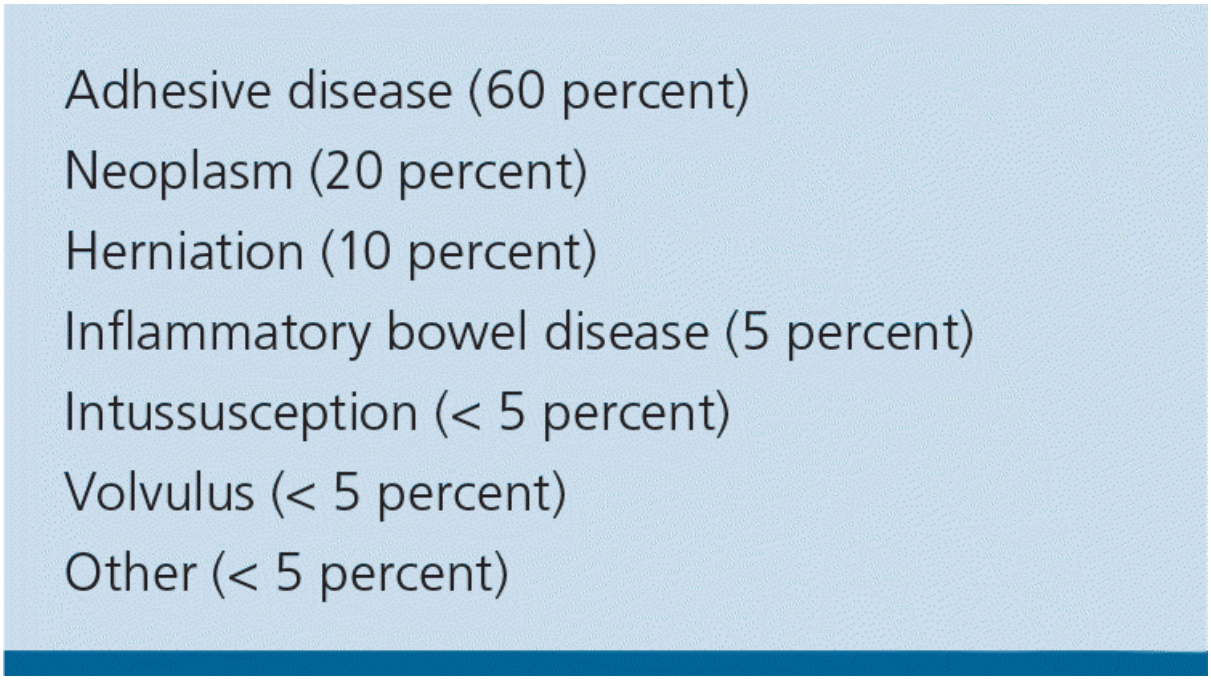


Image 10: Most common causes of intestinal obstruction

Differential Diagnosis

Acute intestinal obstruction should be differentiated from adynamic paralytic ileus and intestinal pseudo-obstruction. Adynamic paralytic ileus is a condition where the neurohormonal mechanism for peristalsis fails to operate leading to failure of passage of contents through the bowel. This may be due to any peritoneal insult, the degree of which, determines the course and severity of the disease. The substances that cause irritation are hydrochloric acid, colonic contents and pancreatic enzymes though blood and urine cause minor irritation. It is also common after an abdominal surgery. Vertebral Injury leading to retroperitoneal hematoma can cause severe adynamic ileus. Other retroperitoneal conditions include ureteral calculus or severe pyelonephritis.

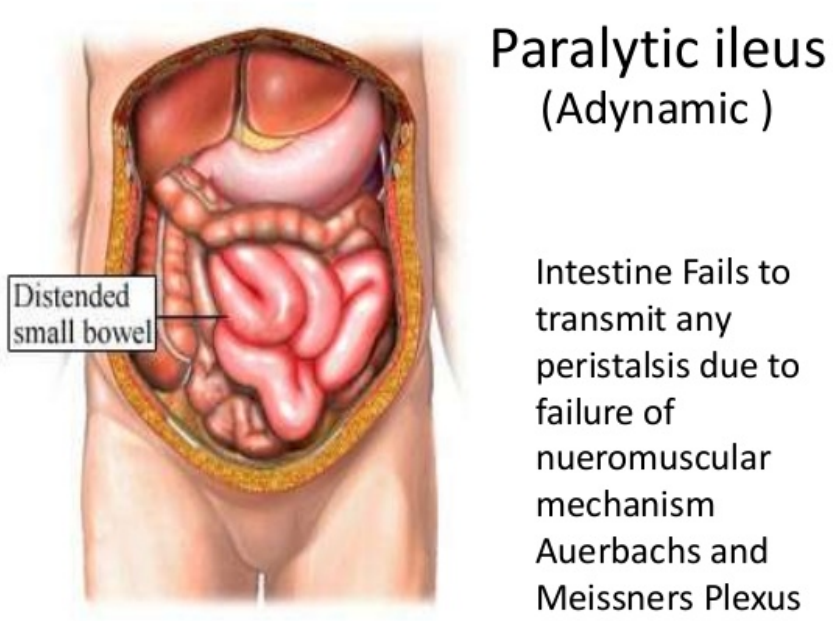


Image 11: Paralytic Ileus

Primary intestinal pseudo-obstruction is a motility disorder of chronic nature that mimic mechanical obstruction. The use of narcotics may lead to acute exacerbations and surgery in such cases should be avoided.

The diagnosis of acute abdomen should constitute all these in the diagnosis algorithm. This would save lot of unnecessary intervention and in turn be economical. The following image shows the various possible etiologies that overlap with the features of acute intestinal obstruction.

Table 2. Differential Diagnosis of Abdominal Pain, Distension, Nausea, and Cessation of Flatus and Bowel Movements

Alternate diagnosis	*Clues*
Ascites	Acute liver failure, history of hepatitis or alcoholism
Medications (e.g., tricyclic antidepressants, narcotics)	Review of medications; diagnosis of exclusion
Mesenteric ischemia	History of peripheral vascular disease, hypercoagulable state, or postprandial abdominal angina; recent use of vasopressors
Perforated viscus/intra-abdominal sepsis	Fever, leukocytosis, acute abdomen, free air on imaging
Postoperative paralytic ileus	Recent abdominal surgery with no postoperative flatus or bowel movement
Pseudo-obstruction (Ogilvie syndrome)	Acutely dilated large intestine, history of intestinal dysmotility, diabetes mellitus, scleroderma

Image 12: Differential Diagnosis of acute intestinal obstruction

An overview of acute Intestinal Obstruction

One of the commonest surgical emergency in abdominal surgery is acute mechanical bowel obstruction[4,5]. It is associated with increased morbidity and economic burden to hospitals globally[6]. It is a major reason for admission in the surgical ICU and emergency[7]. Intestinal obstruction is a serious condition that requires rapid identification, diagnosis and treatment[8,9]. One of the challenges of acute bowel obstruction is the inability to differentiate between simple and

complicated acute intestinal obstruction. This is essential to decide if an emergency surgery is required or non-operative procedures are enough[10,11].

The decision for the management of acute intestinal obstruction should be made based on the various clinical, laboratory and radiological parameters[12]. Even experienced clinicians with good laboratory and radiological procedures find it challenging to decide the mode of management of acute intestinal obstruction[13-15].

Immediate and accurate diagnosis of the obstruction along with the etiology is essential for effective management and good prognosis[16-20]. The clinical picture[21-23], etiology[24-29], prevalence of strangulation[30-32] are not conclusive leading to inconclusive standard method of care[33-39].

Strangulation is the gravest outcome of the illness that might require an emergency procedure. Emergency laparotomy being the treatment of choice. Around 7 to 42% of the intestinal obstructions are faced with the complications of strangulation[40].

Time is golden in the management of acute intestinal strangulation. Earlier is the diagnosis and intervention, better is the prognosis. The diagnosis of strangulation depends on the clinical evaluation and the expertise of the team evaluating the patient.

Pathophysiology of Intestinal Obstruction

The obstruction can happen at any point in the entire length of the intestine due to any of the aforementioned reasons. The manifestations may differ between different degrees of obstruction. The obstruction leads to elevation of the frequency of the migrating motor complexes proximal to the point of obstruction. These contractions lead to severe abdominal cramps. These contractions help to propel the contents of the lumen forward. When the contents are not emptied, they accumulate leading to abdominal distension which leads to retrograde giant contractions manifesting as vomiting.

The increased intraluminal pressure jeopardises the blood supply through the mesenteric veins and completely stops when the pressure equals systolic pressure. This leads to a decrease in the blood flow through the capillaries in the mucosa, leading to rupture and hemorrhagic infiltration. Any twist to the vessels leads to their occlusion and resulting anoxia of the intestinal epithelium and subsequent necrosis. Continued necrosis may lead to perforation. The necrosis may be due to pressure or ischemia. When the obstruction is simple, the proximal part of the intestine in the obstruction is edematous and heavy leading to cyanosis. Further, it may progress to serosal tears.

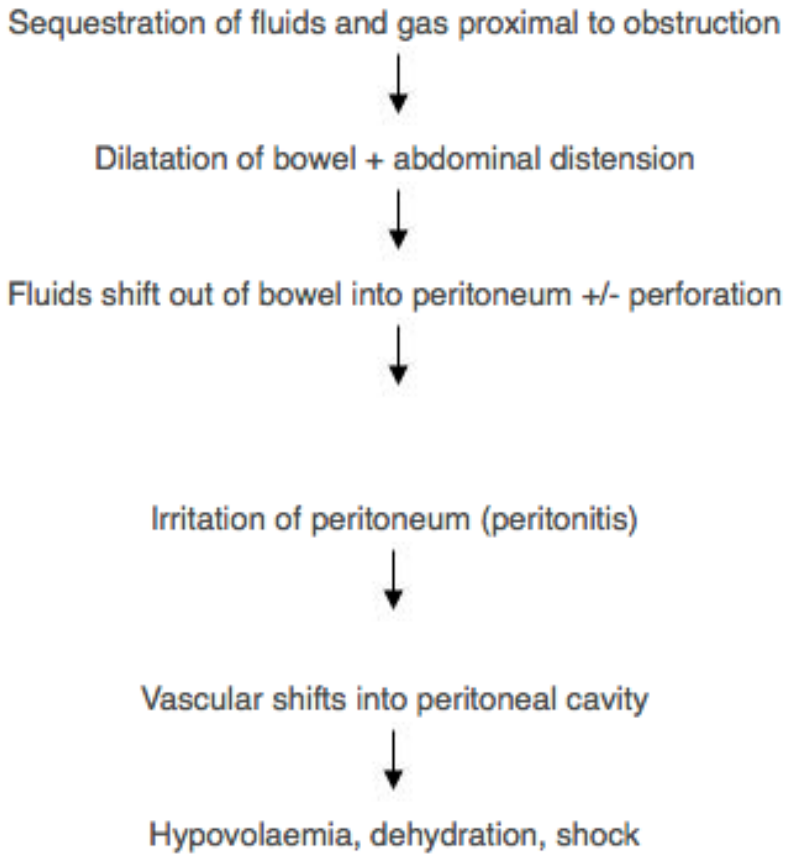


Image 13: Pathophysiology of Acute Intestinal Obstruction

One of the acute physiologic and pathologic response to small bowel obstruction is the depletion in the volume and electrolyte disturbances. Intestinal contents are locked up in the lumen and the fluid is accumulated in the luminal area leading to volume depletion. Vomiting further causes volume depletion and electrolyte disturbances. The electrolyte disturbance depends on the level of obstruction. Proximal obstruction may lead to accumulation of water in the lumen along with sodium and potassium. Edema of the intestine may cause further sequestration of the contents of the intestine. The protein rich exudate may get accumulated in the peritoneal cavity. As obstruction progresses, the collection of fluid in the peritoneum changes from a clear fluid

to a bloody dark exudate. The bacterial flora also undergoes changes as the disease progresses. The fecal type of bacteria increase in the proximal part of the obstruction whereas the distal portion see a drastic change in the bacterial flora[69].

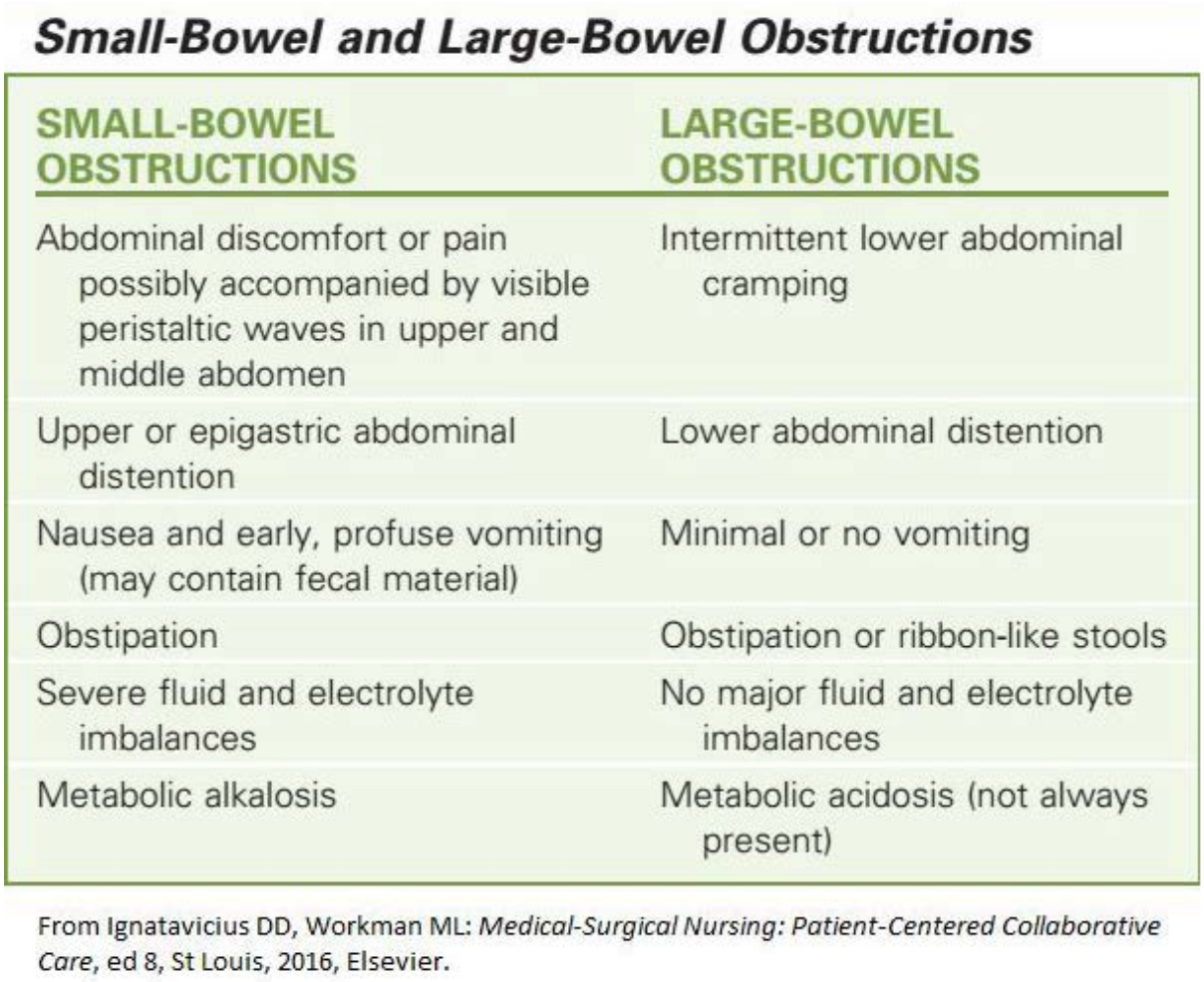
The breakdown of the fluid flora leads to feculent fluid. Finally, when the bowel is strangulated, there is loss of blood in the infracted bowel, tissue death, translocation of the bacteria and the toxic substances and result in perforation.

Symptomatology

The four cardinal symptoms may be present;

1) Pain (colicky)
2) Vomiting
3) Obstipation
4) Distension

The real task is in finding out the level of intestinal obstruction. The following image shows the difference in clinical features of obstruction of small and large intestine.



Small-Bowel and Large-Bowel Obstructions

SMALL-BOWEL OBSTRUCTIONS	LARGE-BOWEL OBSTRUCTIONS
Abdominal discomfort or pain possibly accompanied by visible peristaltic waves in upper and middle abdomen	Intermittent lower abdominal cramping
Upper or epigastric abdominal distention	Lower abdominal distention
Nausea and early, profuse vomiting (may contain fecal material)	Minimal or no vomiting
Obstipation	Obstipation or ribbon-like stools
Severe fluid and electrolyte imbalances	No major fluid and electrolyte imbalances
Metabolic alkalosis	Metabolic acidosis (not always present)

From Ignatavicius DD, Workman ML: *Medical-Surgical Nursing: Patient-Centered Collaborative Care*, ed 8, St Louis, 2016, Elsevier.

Image 14: Difference in clinical features of obstruction of small and large intestine

Pronounced vomiting is present in high SBO. The contents of the vomit may be bile and improperly ingested food. When the SBO is low, the vomit is feculent. In patients with gall stone ileus, tumbling SBO is seen. The tumbling nature corresponds to the impaction of stone, release and re-obstruction. In 20-56%, biliary symptoms may be present. Intussusception may present with intermittent partial bowel obstructive symptoms.

Strangulation and gangrene may not always be clinically evident[70]. Strangulation may be indicated by pain or localised abdominal tenderness, fever, leucocytosis and tachycardia. When these four cardinal signs are not present, the obstruction may be simple. Any simple obstruction showing these classical findings may lead to a diagnosis of strangulation.

Management of acute intestinal obstruction

The management of acute intestinal obstruction depends on the etiology, type and the severity. Any management should be initiated at the earliest to avoid complications. Also, it should be understood that unnecessary surgical intervention should also not be done to avoid post-op complications and adhesions.

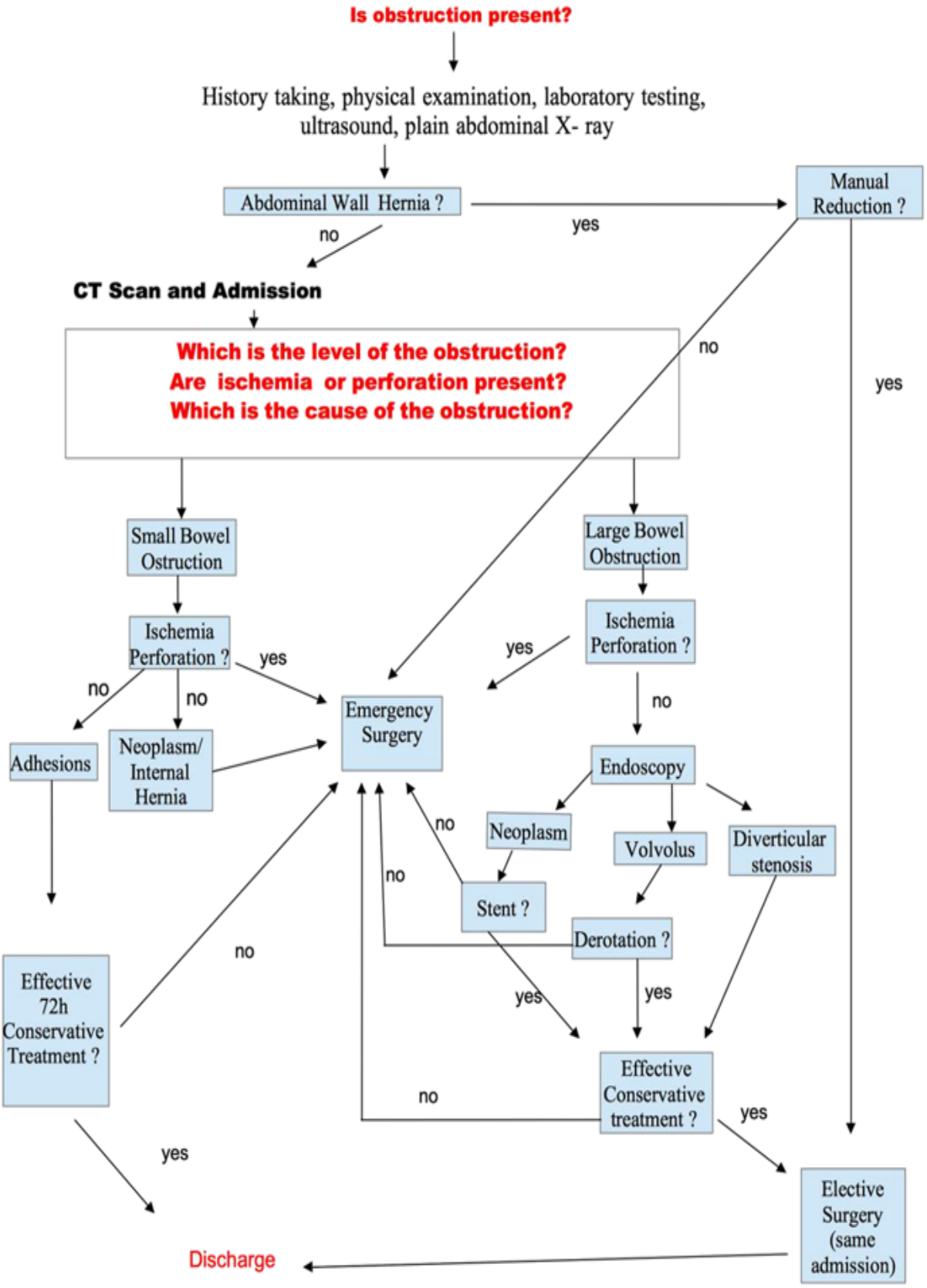
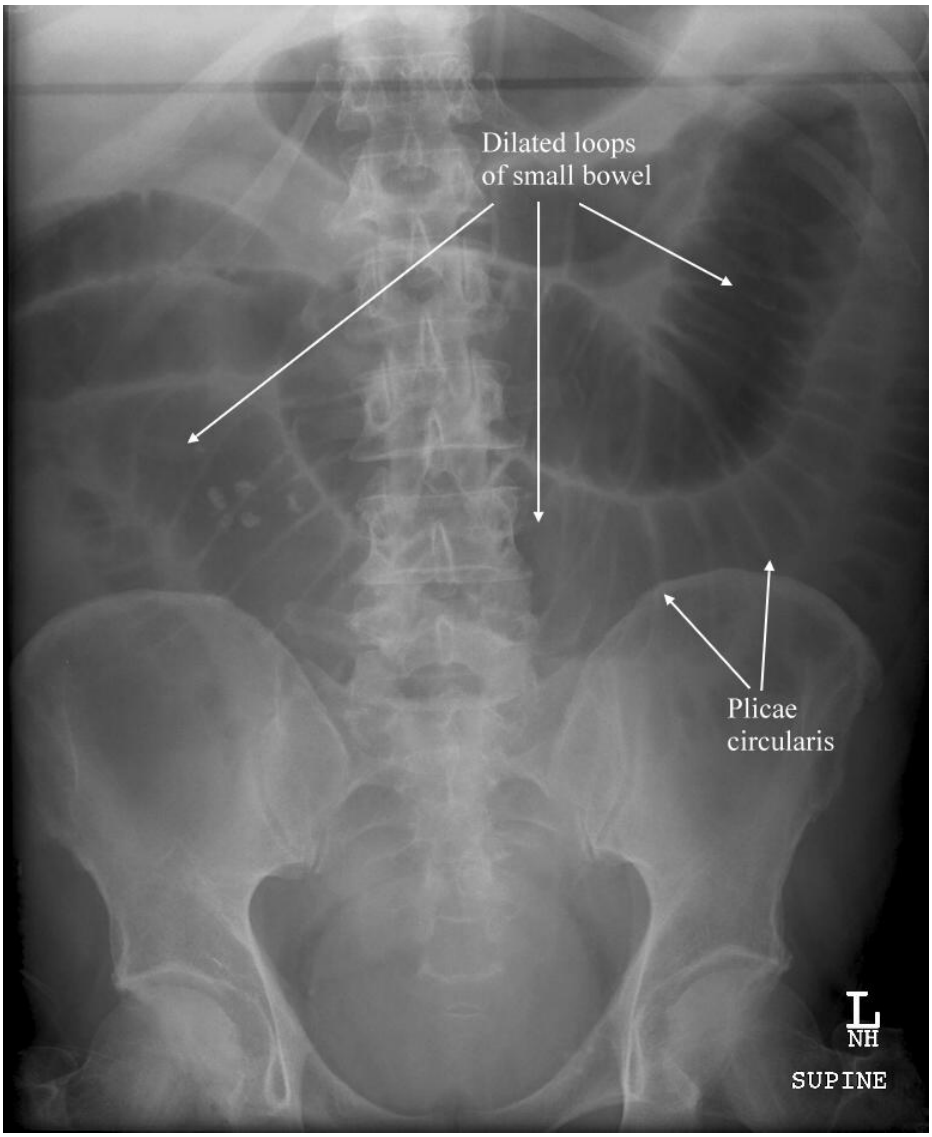


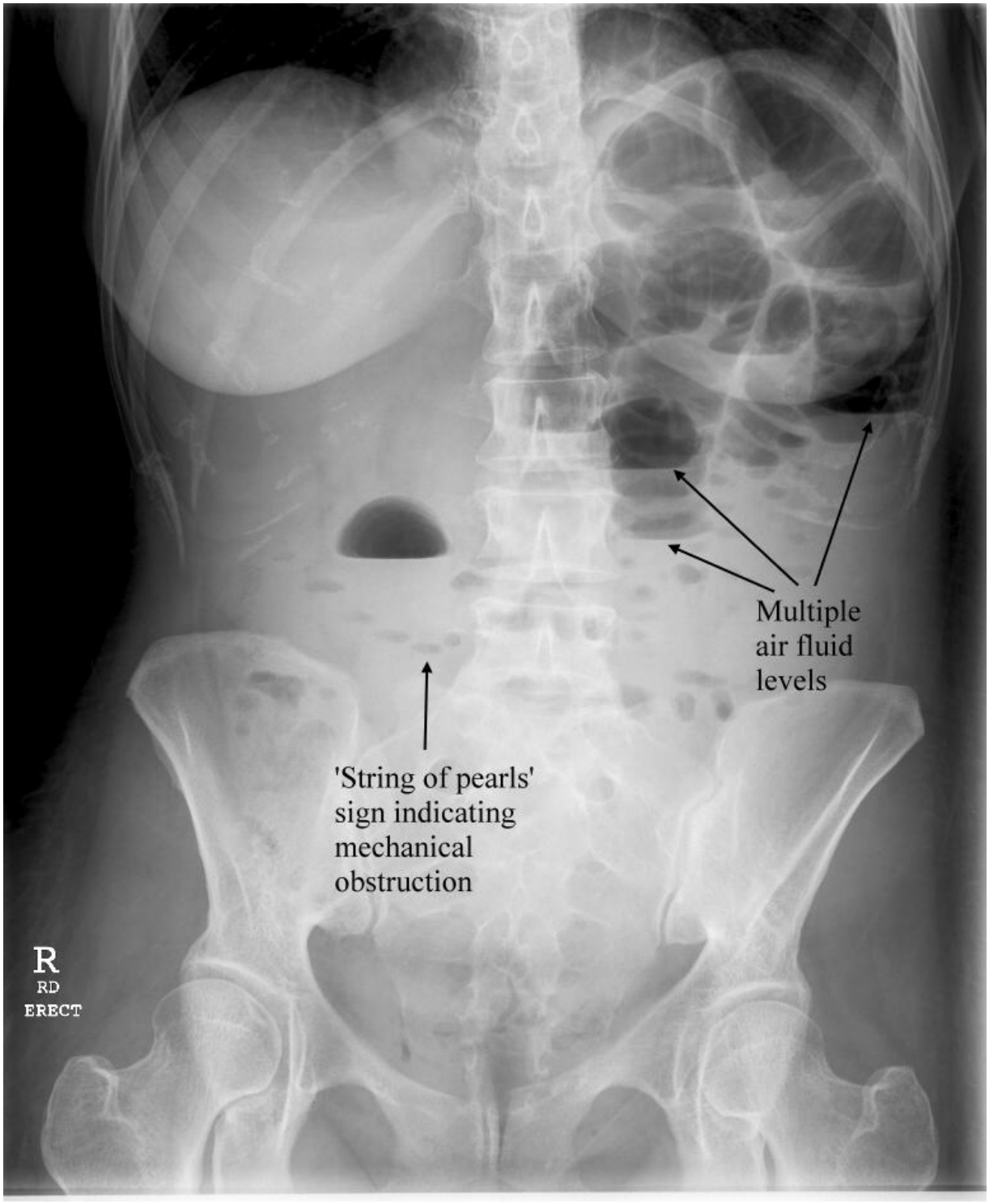
Image 15: Algorithm for Emergency Surgery in Acute Intestinal Obstruction

Laboratory and Radiological Findings

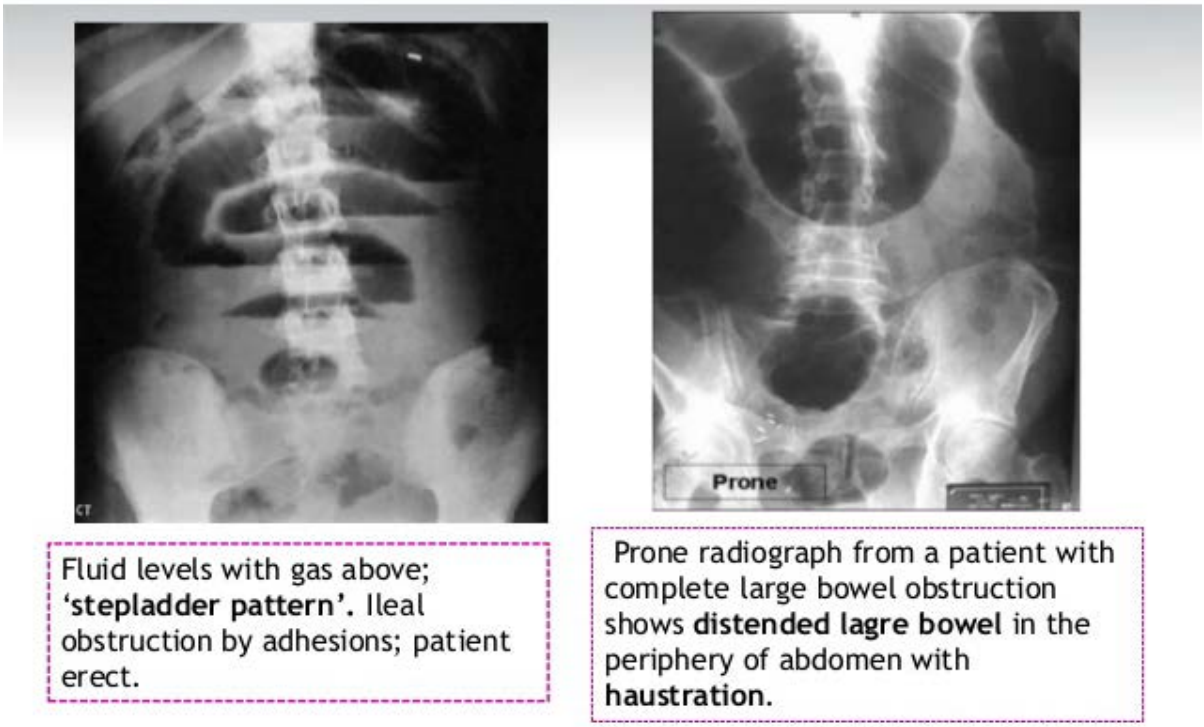
The laboratory examination is routine and does not have specific tests. It helps to differentiate between strangulation and non-strangulation cases and also helps in determining the nature of obstruction if its partial or complete. The following radiological images shows the findings in intestinal obstruction.



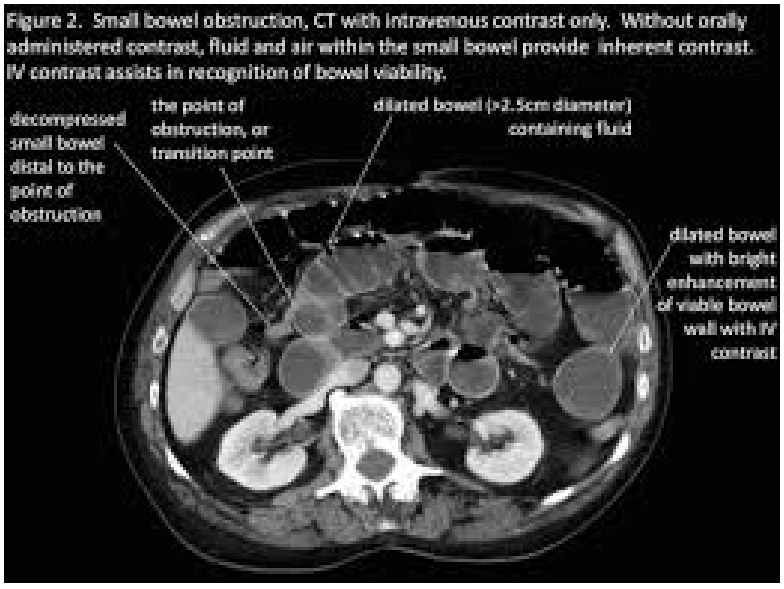
X-ray 1: Dilated Loops of the Bowel



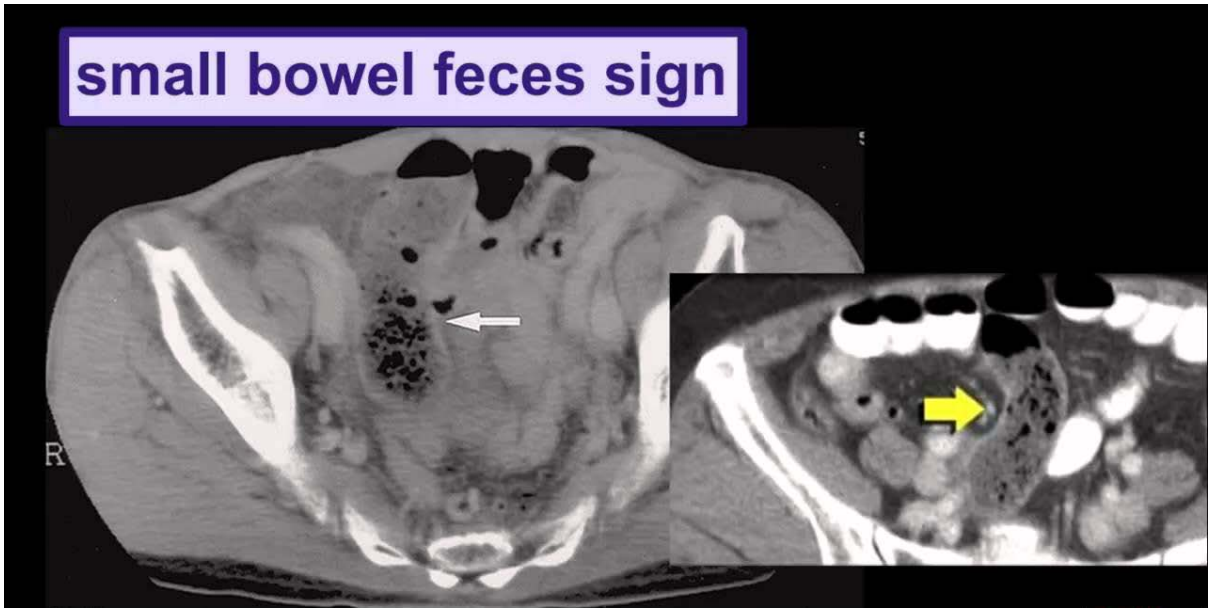
X-ray 2: String of Pearls Sign



X-ray 2: Step Ladder Pattern



CT1: CT Contrast of Small Bowel Obstruction



CT2: Small Bowel Feces Sign

The need for biochemical markers[41-64]

The role of various biochemical markers have been explored and studied to find out if any of them may indicate an intestinal obstruction and be used as an effective and reliable indicator. Some of the markers studied include;serum tumor necrosis factor α ; C-reactive protein (CRP);interleukin 6; D-lactate; D-dimer; alpha glutathione S-transferase; intestinal fatty acid binding protein (I-FABP); creatine kinase B; iso enzymes of lactate dehydrogenase; procalcitonin; alkaline liver phosphatase and urinary phosphate.

But all of them have been studied in animal models with few exceptions of human tissue studies and patients. Still, a vast majority of the literature is incapable of supporting any hypothesis of using these biomarkers leaving a gap in literature.

C-Reactive Protein

This is found in blood, the levels of which is positively correlated with inflammation. CRP is an acute-phase protein that is manufactured in the liver in response to the pro inflammatory factors released by adipocytes[65]. It belongs to a family of proteins called Pentraxin. The levels of CRP are elevated in; inflammation; Infection; Trauma; Tissue Necrosis; Malignancies and Autoimmune disorders.

In this present study, following CRP estimation is going to be done. The system used a specific mouse anti-CRP monoclonal antibody that is directed against a specific antigenic determinant on the CRP molecule. In the antibody enzyme (horseradish peroxidase) conjugate solution, goat anti-CRP antibody is present. The sample was exposed to the two antibodies simultaneously. The CRP molecules gets sandwiched between the enzyme-linked antibodies and solid phase. Values between 0 and 100 ng/mL is measured. The normal reference range for healthy population is 0.08 to 3.1 ng/mL

Lactic Acid

When glucose is broken down in the tissues, Lactic Acid is found as an end product. It exists in two optical isomer forms namely; L-lactate and D-lactate. D-Lactate form is not found in the human body in normal conditions. But when there are acute injuries to the intestinal mucosa, there is an abnormal

multiplication of the bacterial flora of the intestine due to the ischemia of the mesentric arteries[66-68]. In this present study, following lactic acid estimation is going to be done. D-lactate assay kit (colorimetric, ab83429) was used to measure the D-lactate Levels. The kit uses the principle of proportionate colour generation as a result of oxidation of D-lactate by D-lactate dehydrogenase. Values between 0.01 and 10 mmol/mL is measured. The normal reference range for healthy population nano- to micromolar range.

International literature on present study

Not many studies are available on the subject globally. One particular study focused on three cases of acute abdomen (Zainna et al, 2012[71]). This study was methodologically similar to the present study. The following images shows the progress of the illness and CRP and LDH levels.

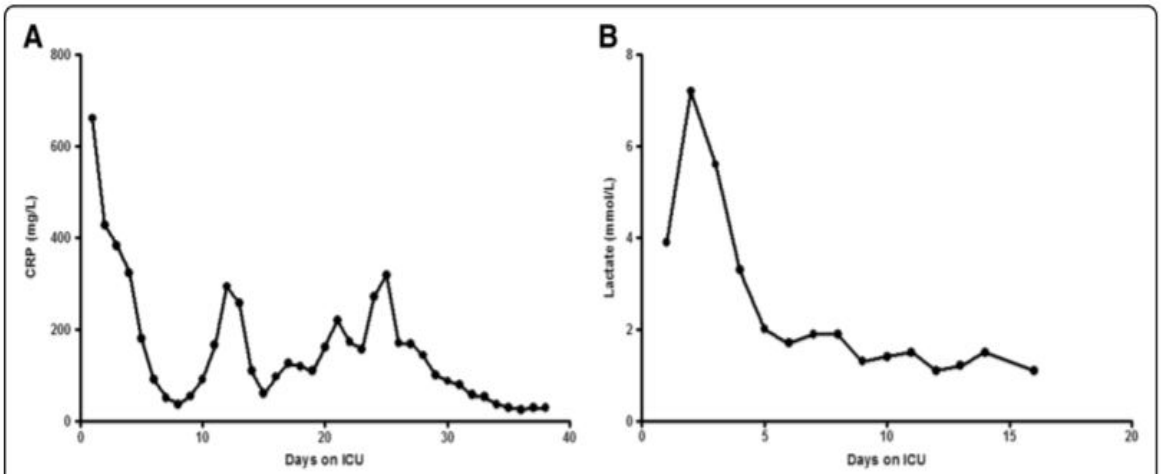


Figure 1 C-reactive protein and lactate concentrations over time of the first case. ***A*** C-reactive protein concentrations and ***B*** Lactate concentrations. C-reactive protein levels and lactate concentrations decreased to near normal values during the ICU stay.

Image 16: CRP and LDH for case 1

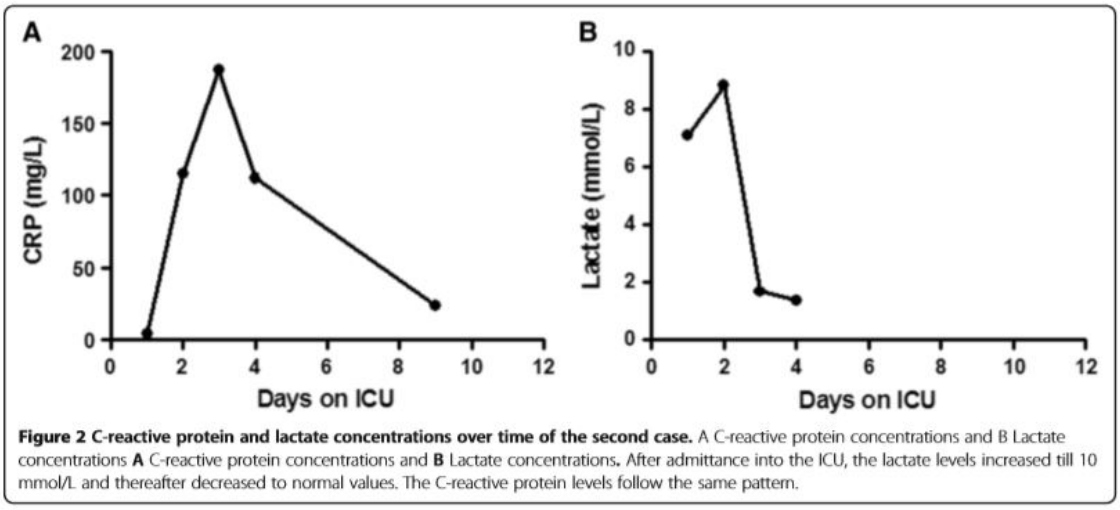


Figure 2 C-reactive protein and lactate concentrations over time of the second case. A C-reactive protein concentrations and B Lactate concentrations **A** C-reactive protein concentrations and **B** Lactate concentrations**.** After admittance into the ICU, the lactate levels increased till 10 mmol/L and thereafter decreased to normal values. The C-reactive protein levels follow the same pattern.

Image 17: CRP and LDH for case 2

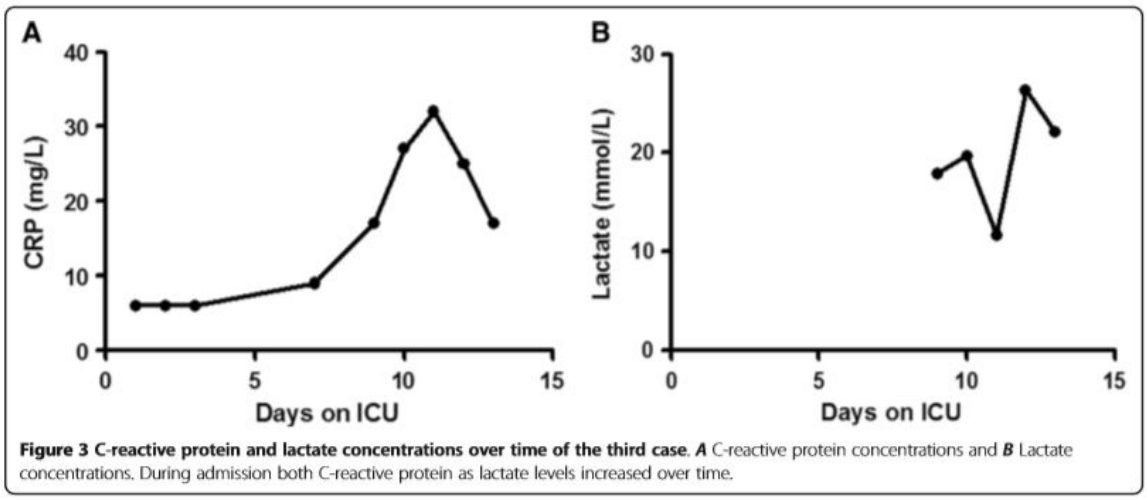


Figure 3 C-reactive protein and lactate concentrations over time of the third case. ***A*** C-reactive protein concentrations and ***B*** Lactate concentrations. During admission both C-reactive protein as lactate levels increased over time.

Image 18: CRP and LDH for case 3

In the above study, these cases demonstrate that although biomarkers CRP and lactate can be useful in the diagnosis of an acute abdomen, they are not specific and can be misleading in establishing a diagnosis. In addition, relying on these biomarkers may contribute to more diagnostic examinations and/or unnecessary invasive interventions (e.g. laparotomy). We conclude that lactate levels and

CRP concentrations in patients with acute abdominal pain should only be used in adjunction to the history and clinical findings and perhaps to a CT-scan as well.

Need for Study

Therefore, this study was aimed at understanding the combination of raised serum C-Reactive Protein and D – Lactate as useful biomarkers in prediction of bowel gangrene in intestinal obstruction.

MATERIALS AND METHODS

MATERIALS AND METHODS

Aims and objectives of the study:

To study on combination of raised serum C - reactive protein and D – Lactate as useful biomarkers in prediction of bowel gangrene in intestinal obstruction.

Study design

Prospective Single Centre Study

Place of study

GMKMC hospital

Study period

2017 to 2019

Study population & Sampling Methodology

- Cases admitted to GMKMC hospital Salem with signs of intestinal obstruction in Emergency ward will be closely monitored from the day of admission to the day of discharge.
- The patients with signs of intestinal obstruction and strangulation admitted in emergency ward between 2017 and 2019 were chosen.
- This study comprises 100 patients presenting with signs of intestinal obstruction and strangulation.

Inclusion criteria:

- All the patients with signs of intestinal obstruction admitted in emergency ward.

Exclusion criteria:

- Patients not Willing For Study
- Mesenteric Vascular Ischemia

Methodology

A total of 100 consecutive adult patients presenting to the emergency department of GMKMC hospital, Salem with signs of intestinal obstruction were recruited. The patients who were clinically suspected of intestinal obstruction and those operated in the emergency theatre were also a part of the study. The intraoperative findings led to the formation of two groups namely; those with simple obstruction and those with strangulated bowel obstruction. Patients who had confounding factors like comorbid conditions of;

- chronic kidney diseases
- cardiac ailments
- diabetes mellitus
- coagulopathy

were not included in the study. These diseases are capable of altering the course of illness of the study. Diabetes and Chronic Kidney Disease may also lead to

false-positive results. Other intraoperative findings were also excluded from the study.

The following data was collected using a structured questionnaire:

- Age
- Demographic characteristics
- Socio economic status
- Clinical findings:
- Patients complaints
- Duration of complaints
- Diffuse pain
- Generalized distension of abdomen
- Vomiting
- Fever
- Obstipation
- History of previous abdominal surgery
- Shock (systolic blood pressure <90 mm Hg)
- Tenderness
- Guarding or rigidity
- Exaggeration of bowel sounds

Laboratory Tests

Venous Blood Samples from 100 patients were collected at the time of presentation in the department of emergency before 20 minutes from their time of arrival.

All patients who were suspected for acute intestinal obstruction were selected and once the diagnosis was confirmed, the same was recruited into the study.

The collected blood was sent for biochemistry analysis;

a) Separation of sera by centrifugation
b) Storage in sterile vials at –20°C
c) Measurement of total leukocyte count (TLC)
d) Serum CRP levels were measured
e) Serum D-lactate levels were measured

Serum CRP levels were measured using;

- human CRP kit (hsCRP ELISA, 96 wells, OKBA00016
- based on the principle of solid phase enzyme-linked immunosorbent assay

Methodology of estimation

Serum CRP

- The system used a specific mouse anti-CRP monoclonal antibody that is directed against a specific antigenic determinant on the CRP molecule.
- In the antibody enzyme (horseradish peroxidase) conjugate solution, goat anti-CRP antibody is present
- The sample was exposed to the two antibodies simultaneously
- The CRP molecules gets sandwiched between the enzyme-linked antibodies and solid phase
- Values between 0 and 100 ng/mL is measured
- The normal reference range for healthy population is 0.08 to 3.1 ng/mL

D-Lactate

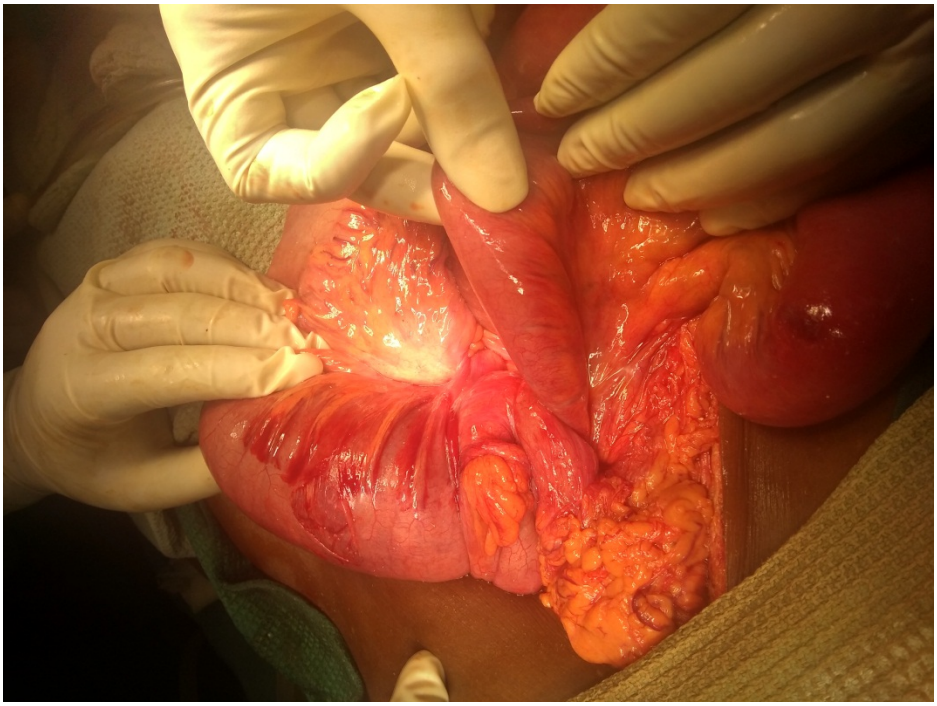
- D-lactate assay kit (colorimetric, ab83429) was used to measure the D-lactate Levels
- The kit uses the principle of proportionate colour generation as a result of oxidation of D-lactate by D-lactate dehydrogenase
- Values between 0.01 and 10 mmol/mL is measured
- The normal reference range for healthy population nano- to micromolar range

Statistical Analysis

Data were analyzed according to history, clinical examination and investigations (white blood cells, serum CRP, and serum D-lactate). Data were entered in excel sheet and analyzed using IBM SPSS v23. Frequencies and percentage analysis were done. Cross tabulation and Chi-square analyses were done to find the relationship and association between various variables. The p-values of <0.05 were considered to be statistically significant.

Images from the surgery


Santhi
Cva. Jejunal gangrene. Resection
and double barrel ostomy done on
25.5.19



RESULTS

Results

A Prospective Study on Combination of Raised Serum C - reactive protein and D – Lactate as Useful Biomarkers in Prediction of Bowel Gangrene in Intestinal Obstruction included 100 patients presenting with signs of intestinal obstruction and strangulation. All patients presenting with acute intestinal obstruction of were selected, serum CRP & D-lactate were taken pre operatively and their increase were correlated with per operative findings of bowel gangrene.

The age distribution of the patients is given below. The mean age is 51.13 years with a standard deviation of 12.2 years. The majority of the patients were males (n=53, 53%) and the rest were females (n=47, 47%).Abdominal pain was seen in fifty patients (50%) and the rest did not have abdominal pain (n=80, 80%). Irreducible swelling was present in 40% (n=40) of the patients while the remaining (n=60, 60%) did not have irreducible swelling.

The incidence of vomiting in patients was 52% (n=52) while 48% of them (n=48) did not have vomiting. Around 45% (n=45) cases presented with obstipation while the rest did not have obstipation. Abdominal distension was present in 48% (n=48) of the cases while the remaining 52% (n=52) did not have abdominal distension. Guarding was present in 60% (n=60) of the cases while the rest (n=40, 40%) did not have guarding or rigidity.

The patients presenting with bowel sounds were 35% (n=35) while the rest (n=65, 65%) did not have bowel sounds. Majority of them had symptoms for more than 48 hours (n=62, 62%). Around 22% (n=22) of them had symptoms between 24-48 hours while the rest (n=16, 16%) had symptoms for less than 24 hours. Around 81% (n=81) did not have any history of previous surgery. The gangrene of the bowel was present in 31% (n=31) of the cases while the rest were normal (n=56, 56%) or pregangrenous state (n=13, 13%).

The mean serum LDH was high (mean=869, S.D=192) and serum CRP was high (mean=126, S.D=29.87) in patients with gangrene.

The serum LDH and Serum CRP are useful Biomarkers in Prediction of Bowel Gangrene in Intestinal Obstruction.

Age distribution of the participants

The age distribution of the patients is given below. The mean age is 51.13 years with a standard deviation of 12.2 years.

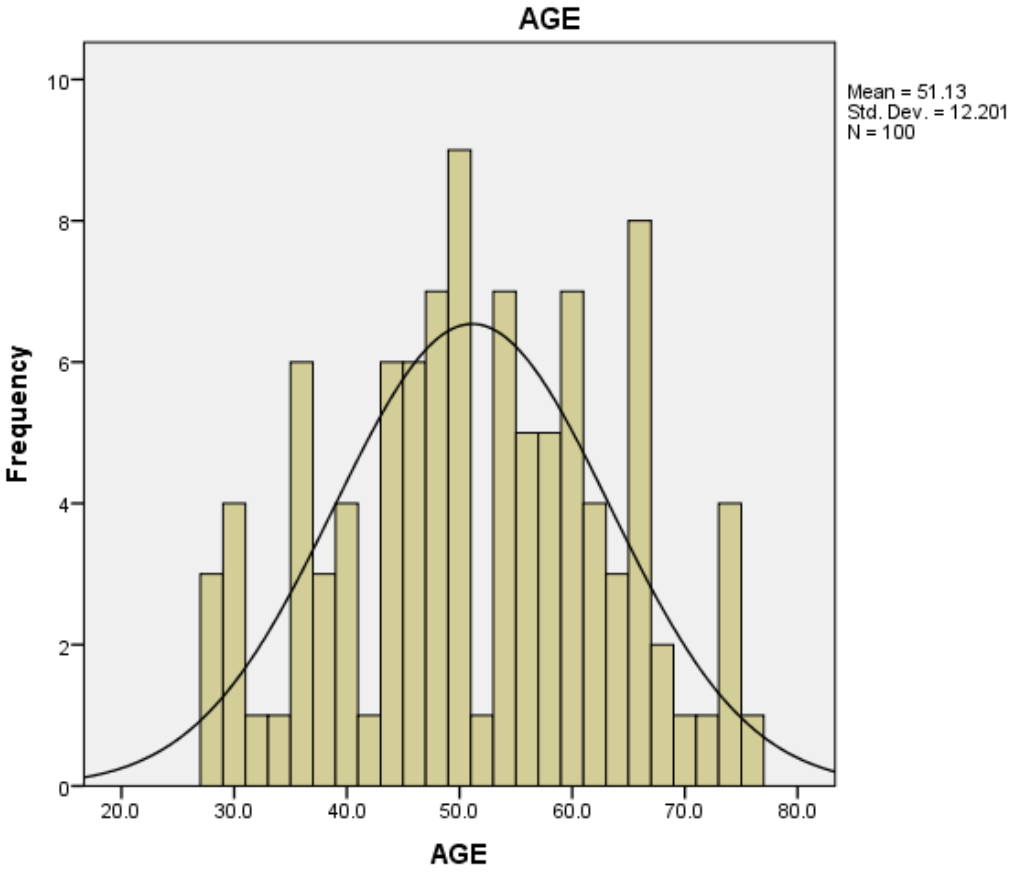


Figure 1: Age distribution of the participants

Gender Distribution of the participants

The majority of the patients were males (n=53, 53%) and the rest were females (n=47, 47%). The following figure shows the gender distribution of the participants.

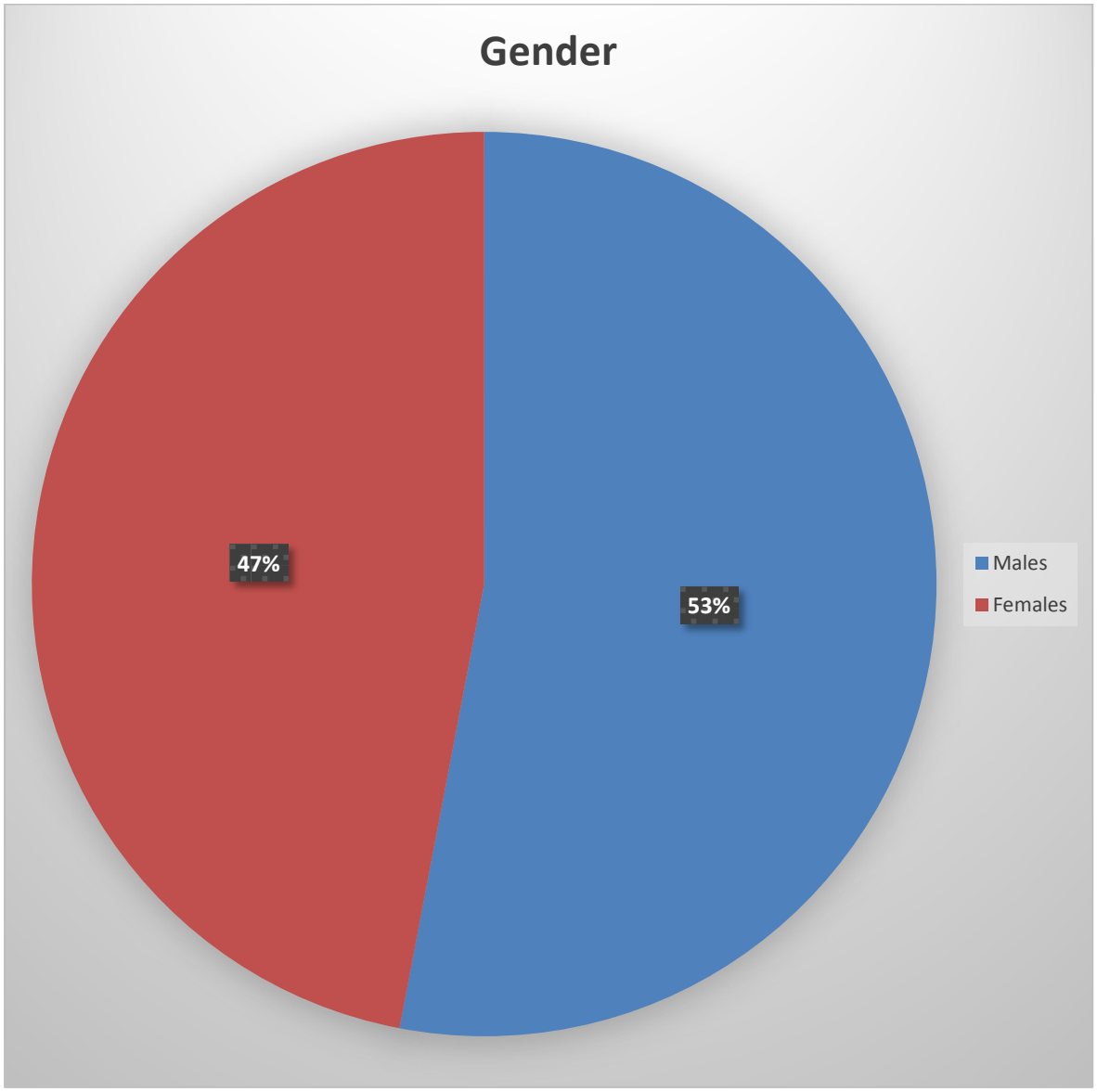


Figure 2: Gender distribution of the participants

Presenting complaints, signs and symptoms

Patients presented with abdominal pain, irreducible swelling, vomiting, obstipation, abdominal distension, guarding and rigidity and bowel sounds.

Abdominal Pain

Abdominal pain was seen in eight patients (80%) and the rest did not have abdominal pain (n=20, 20%).

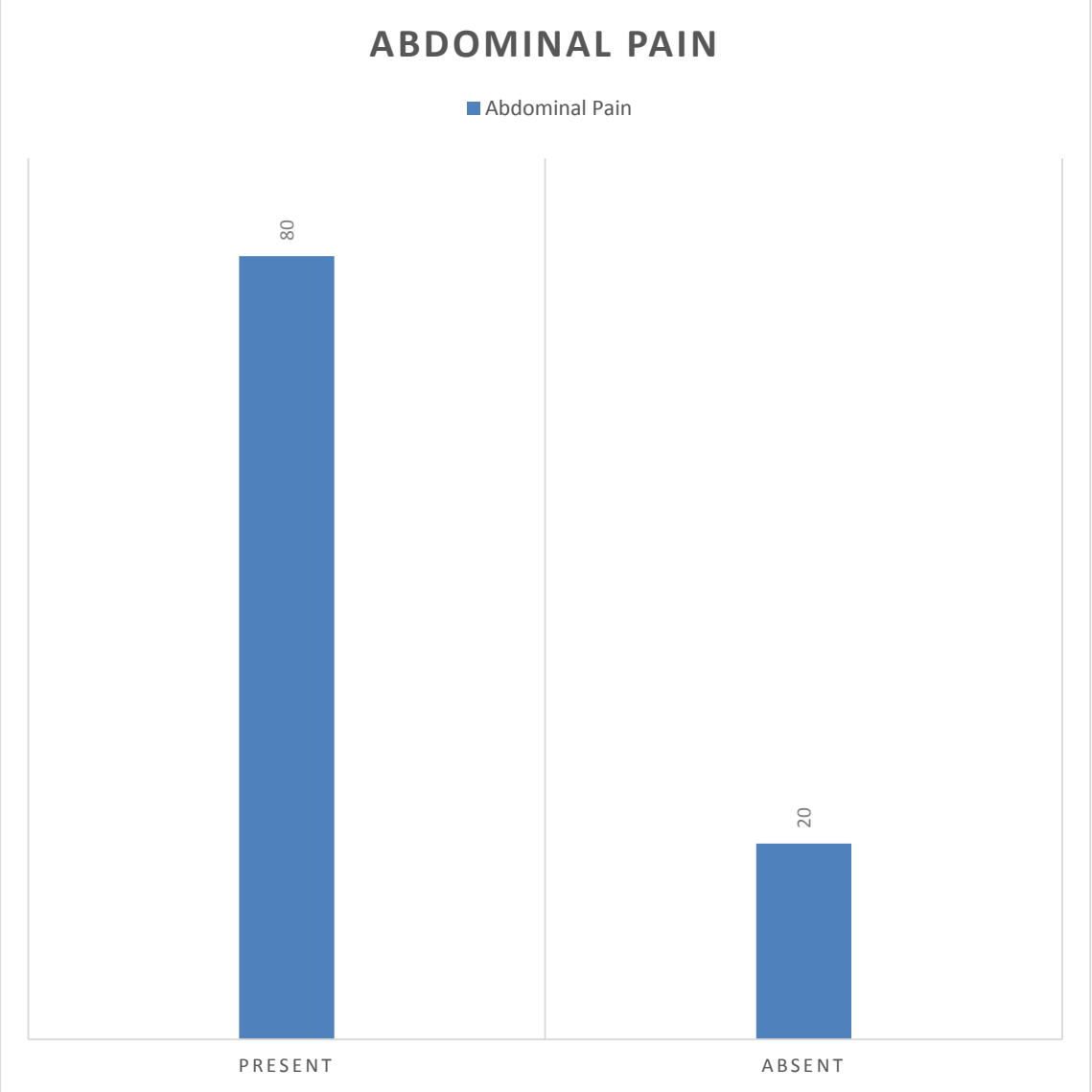


Figure 3: Abdominal Pain

Irreducible Swelling

Irreducible swelling was present in 40% (n=40) of the patients while the remaining (n=60, 60%) did not have irreducible swelling.

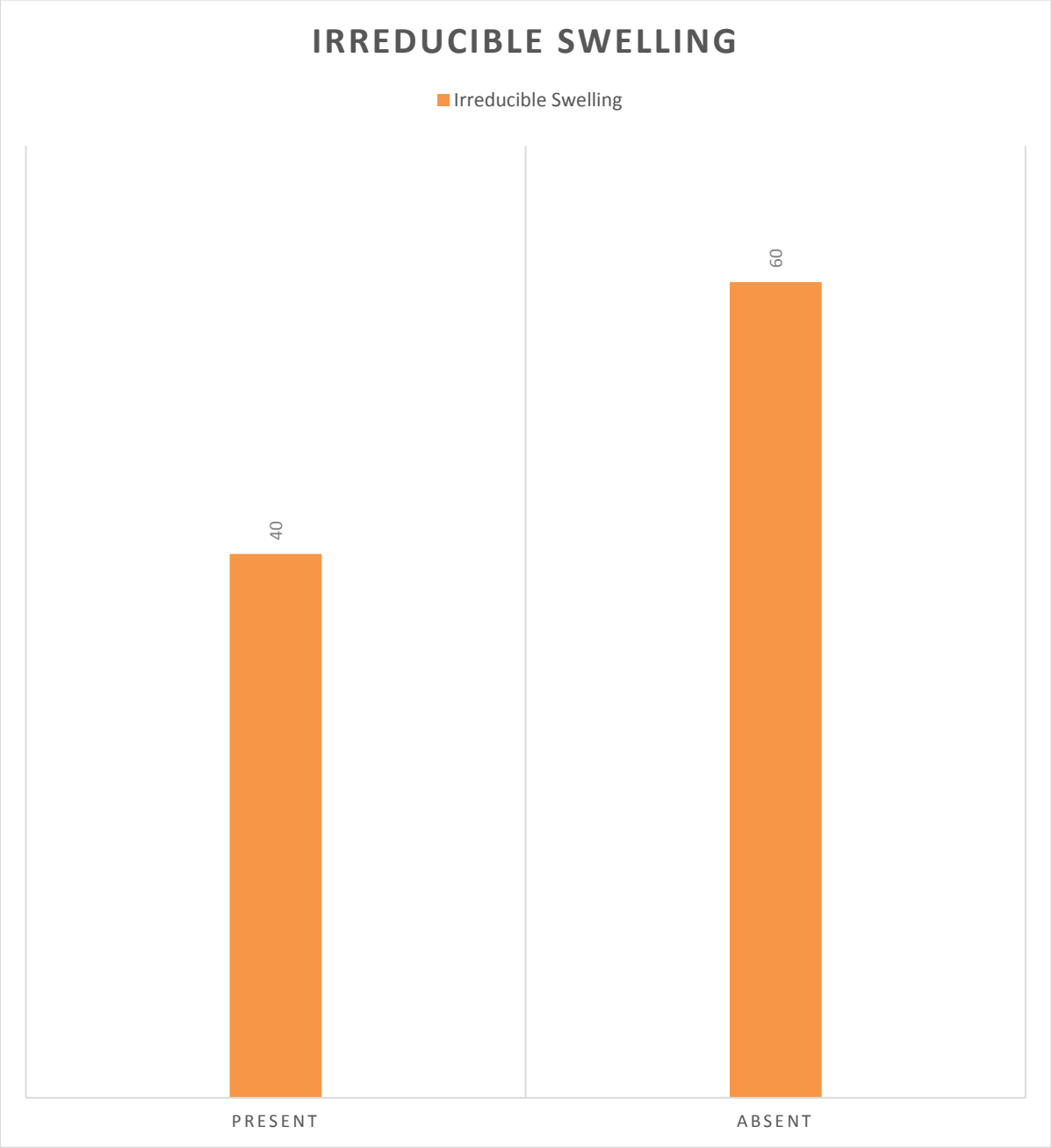


Figure 4: Irreducible swelling

Vomiting

The incidence of vomiting in patients was 52% (n=52) while 48% of them (n=48) did not have vomiting.

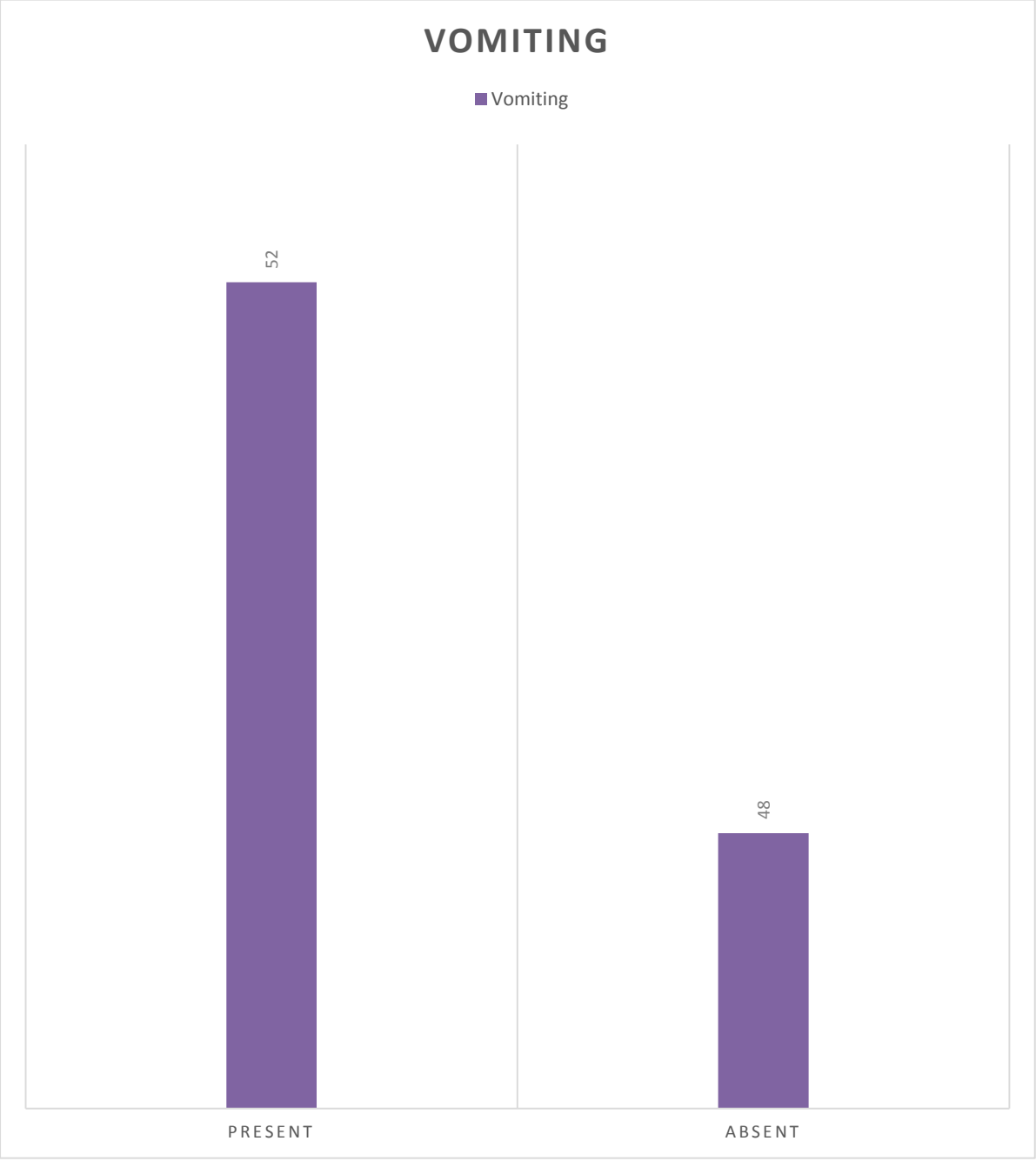


Figure 5: Vomiting

Obstipation

Around 45% (n=45) cases presented with obstipation while the rest did not have obstipation.

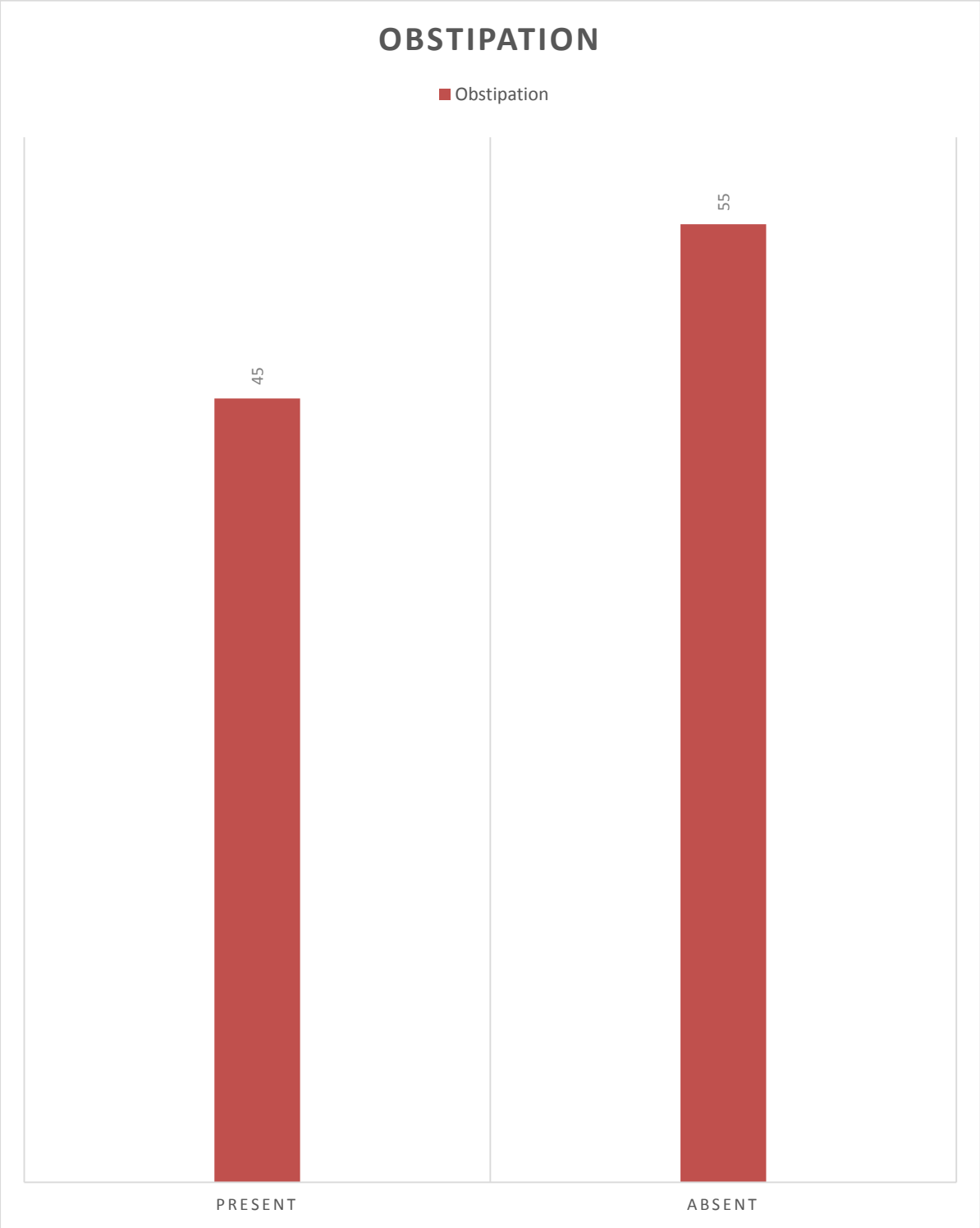


Figure 6: Obstipation

Abdominal Distension

Abdominal distension was present in 48% (n=48) of the cases while the remaining 52% (n=52) did not have abdominal distension.

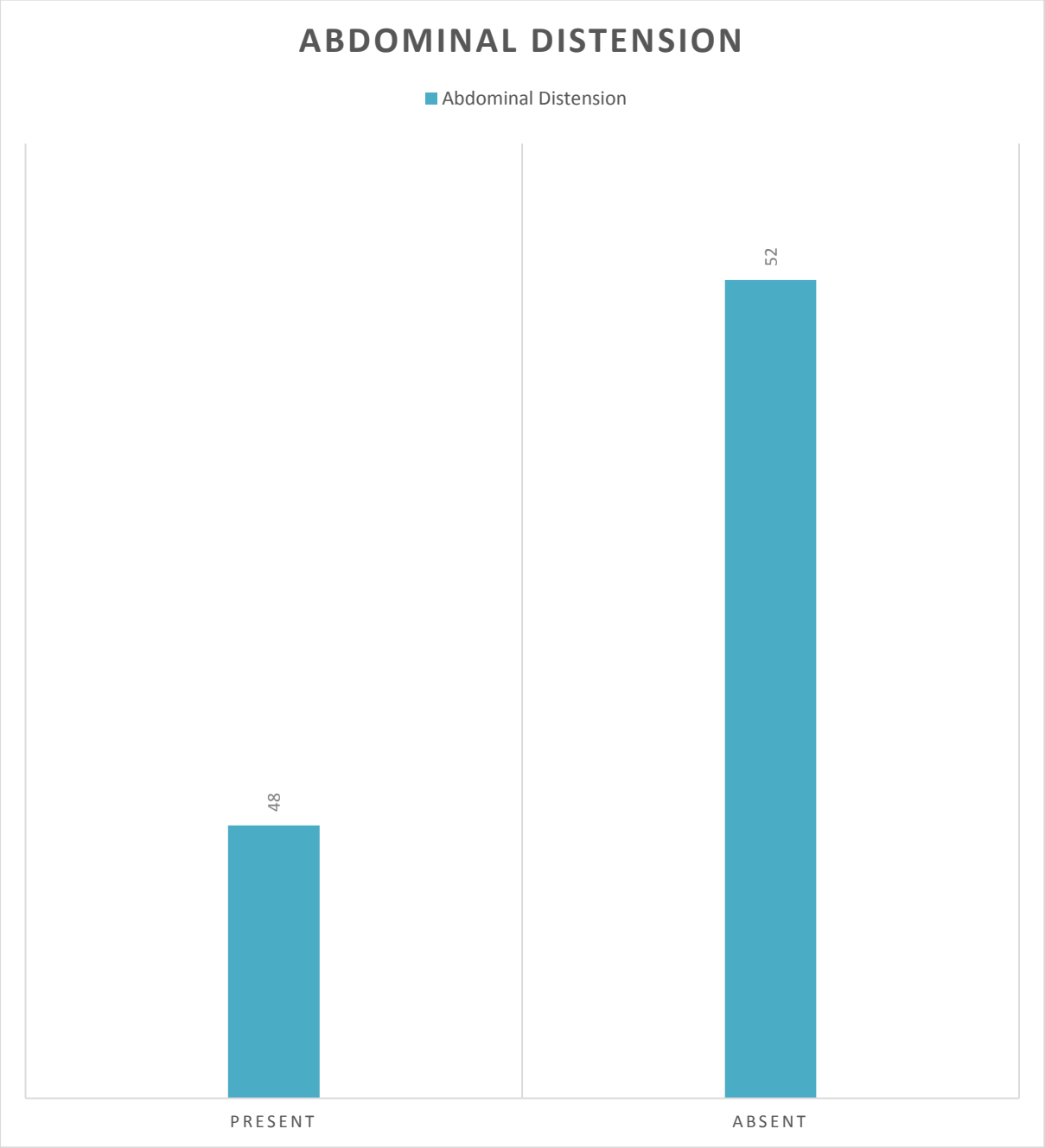


Figure 7: Abdominal Distension

Guarding/ Rigidity

Guarding was present in 60% (n=60) of the cases while the rest (n=40, 40%) did not have guarding or rigidity.

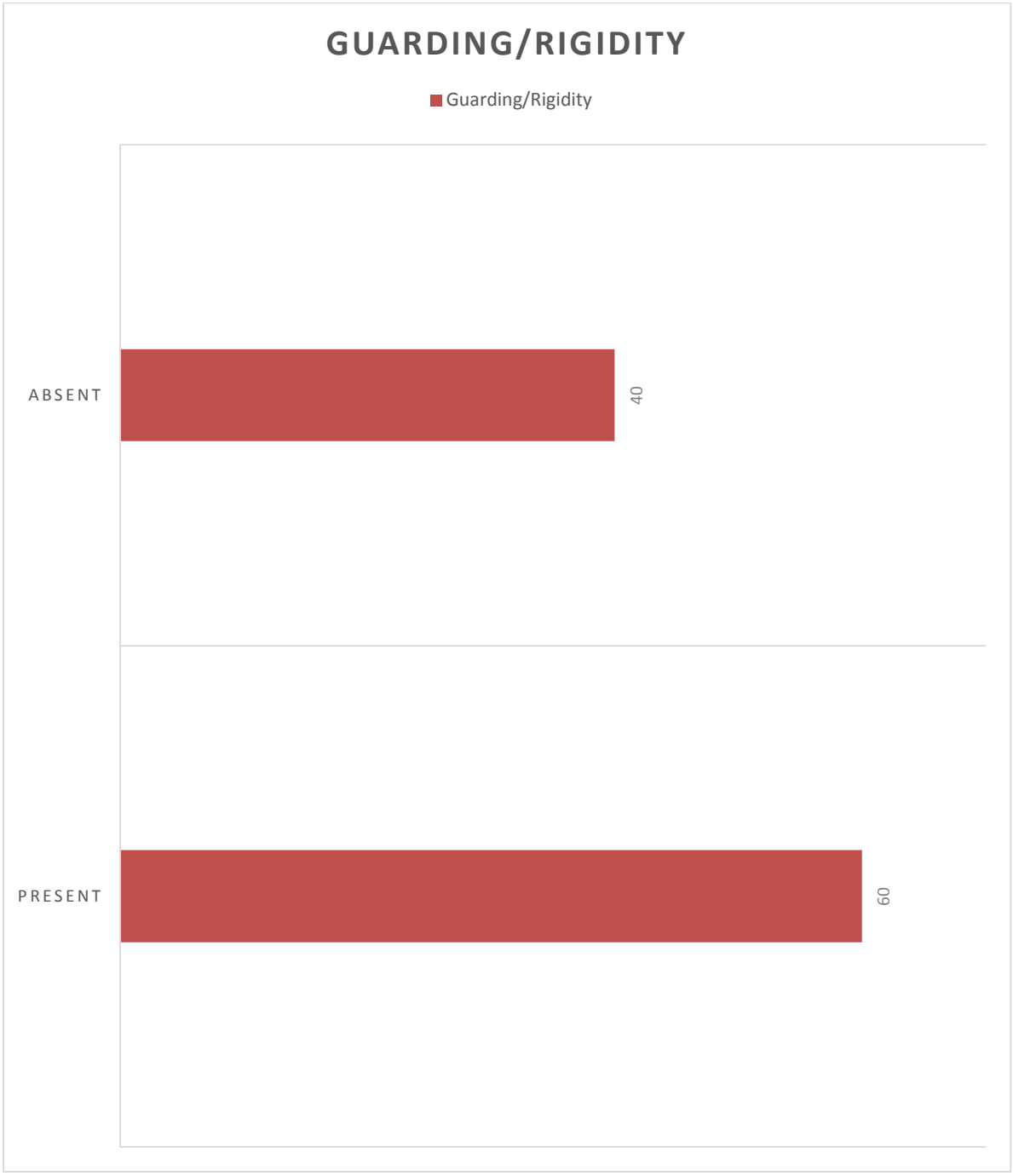


Figure 8: Guarding/ Rigidity

Bowel Sounds

The patients presenting with bowel sounds were 35% (n=35) while the rest (n=65, 65%) did not have bowel sounds.

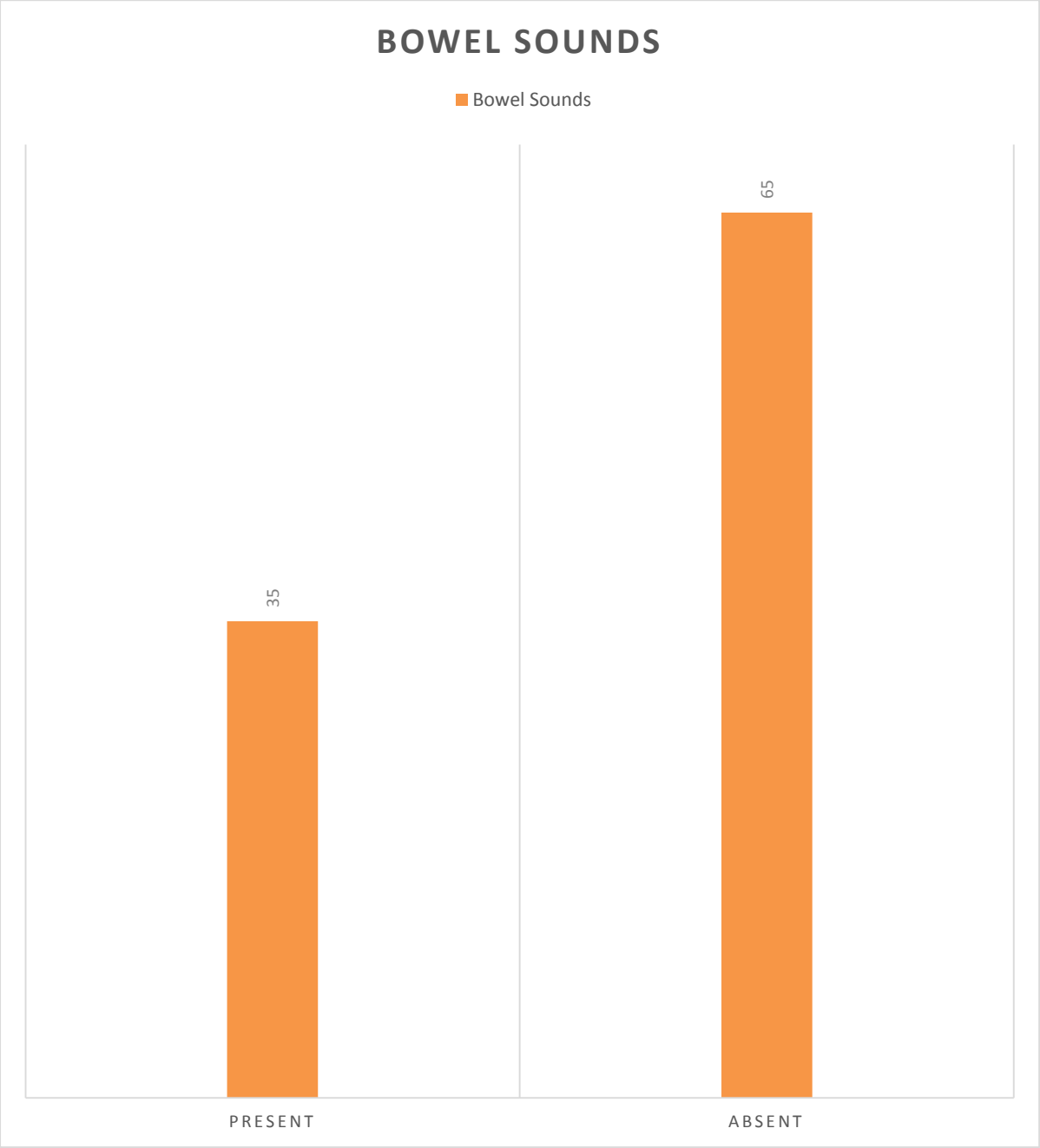


Figure 9: Bowel Sounds

Duration of the symptoms

Majority of them had symptoms for more than 48 hours (n=62, 62%). Around 22% (n=22) of them had symptoms between 24-48 hours while the rest (n=16, 16%) had symptoms for less than 24 hours.

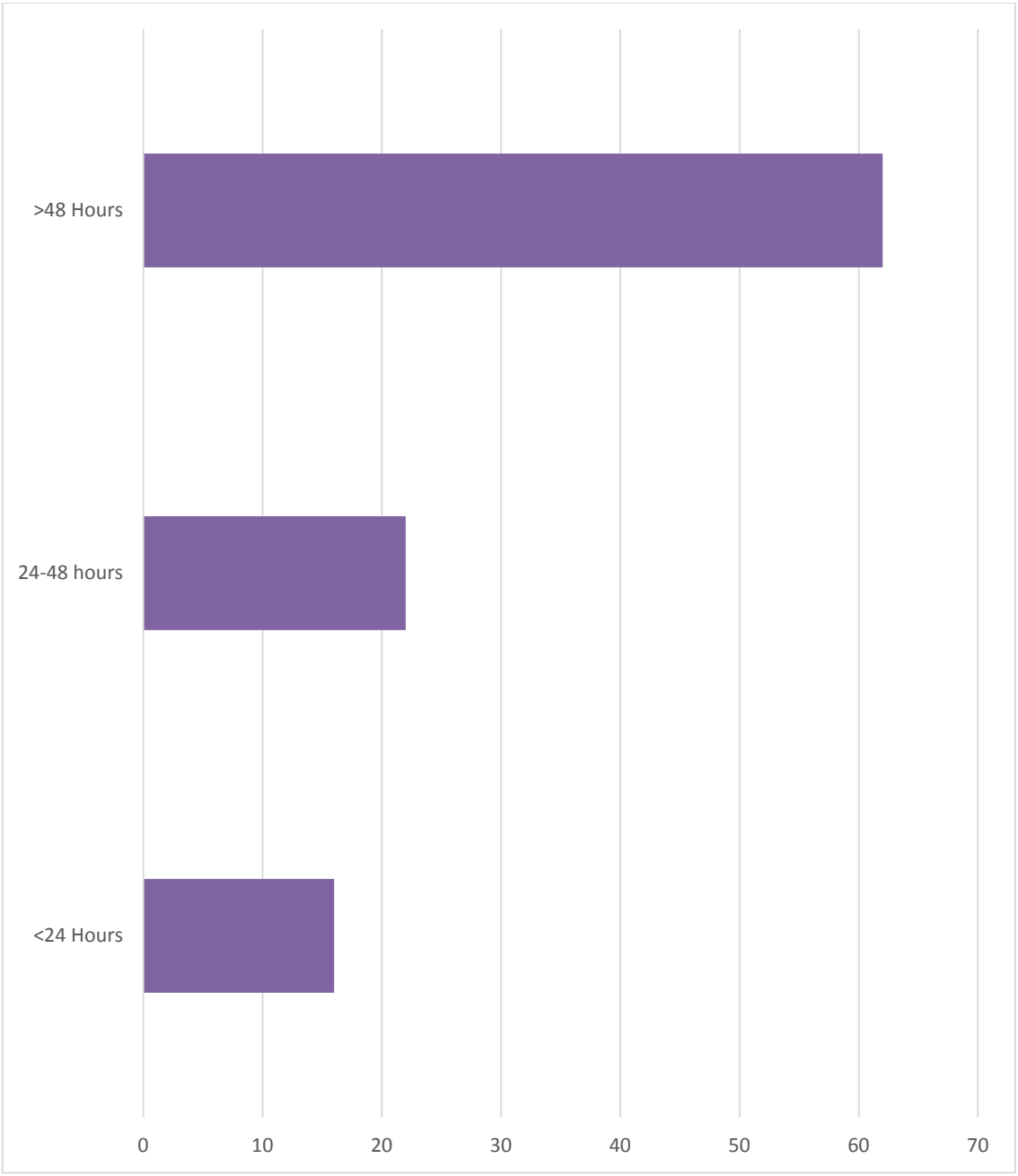


Figure 10: Duration of symptoms

Past history of surgery

The following table shows the history of previous surgery. Around 81% (n=81) did not have any history of previous surgery.

Previous Surgery	Frequency	Percentage
Appendicectomy	3	3.0
Appendicectomy & hysterectomy	1	1.0
Hysterectomy	3	3.0
Laparotomy - obstruction	2	2.0
Laparotomy - perforation	4	4.0
Laparotomy - tumour excision	2	2.0
Laparotomy- tumour excision	1	1.0
Repeated laparotomy - adhesiolysis	1	1.0
Umbilical hernia repair	2	2.0
Nil	81	81.0
Total	100	100.0

Table 1: Past history of Surgery

Etiology of obstruction

The following table show the Etiology of obstruction.

Etiology	Frequency	Percentage
Adhesive Intestinal Obstruction	13	13.0
Carcinoma Colon	10	10.0
Internal Hernia	2	2.0
Intussusception	5	5.0
Obstructed Femoral Hernia	14	14.0
Obstructed Internal Hernia	26	26.0
Post-operative Contraction Band	16	16.0
Sigmoid Volvulus	10	10.0
Uremic Bowel Obstruction	4	4.0
Total	100	100.0

Table 2: Etiology

Gangrene of the Bowel

The gangrene of the bowel was present in 31% (n=31) of the cases while the rest werenormal (n=56, 56%) or pregangrenous state (n=13, 13%).

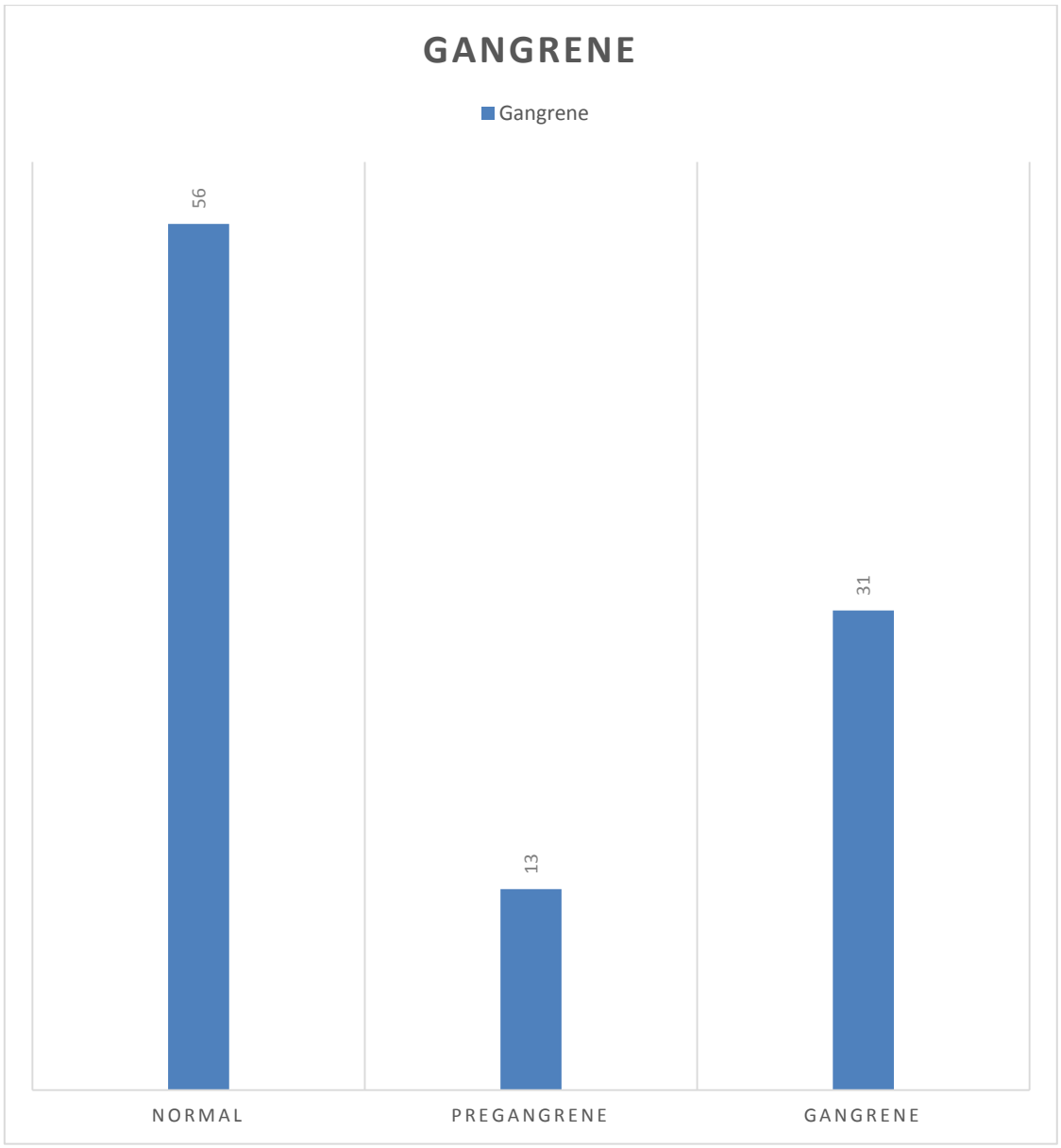


Figure 11: Gangrene

Serum LDH and Serum CRP

Figure 12 and 13 shows the level of serum LDH and CRP in all the 100 patients while figure 14 and 15 shows serum LDH and CRP in normal bowel; figure 16 and 17 shows serum LDH and CRP in pregangrene patients while figure 18 and 19 shows serum LDH and CRP in gangrene patients.

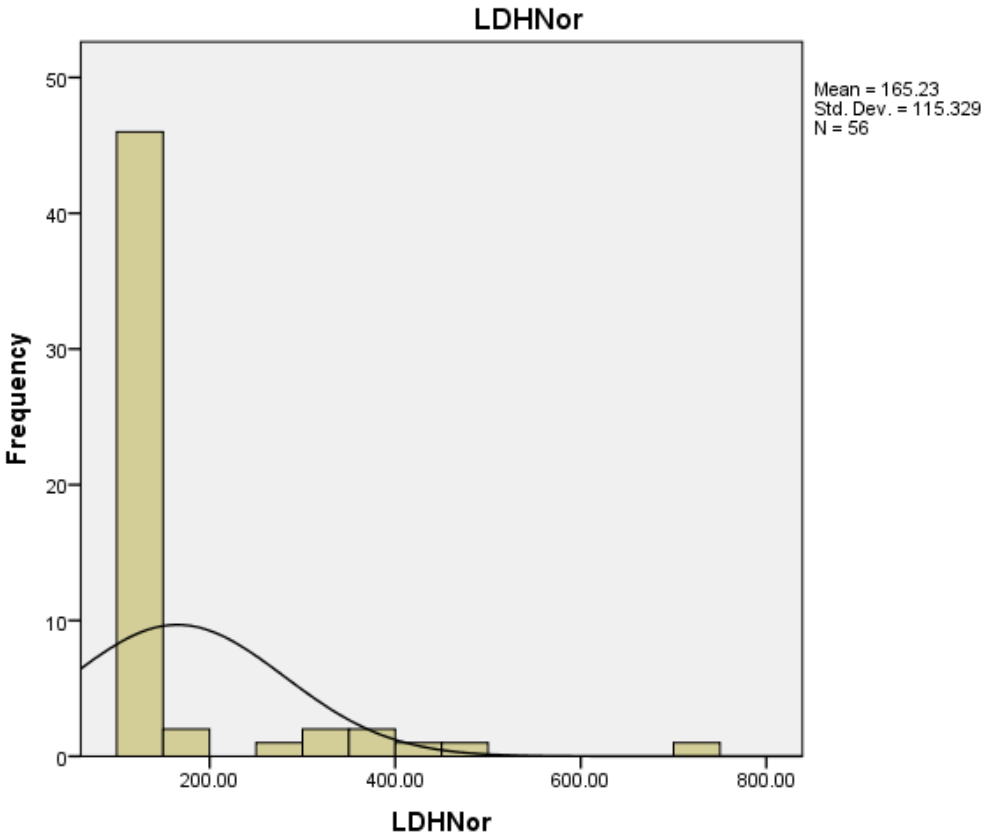


Figure 12: Serum LDH in Normal patients

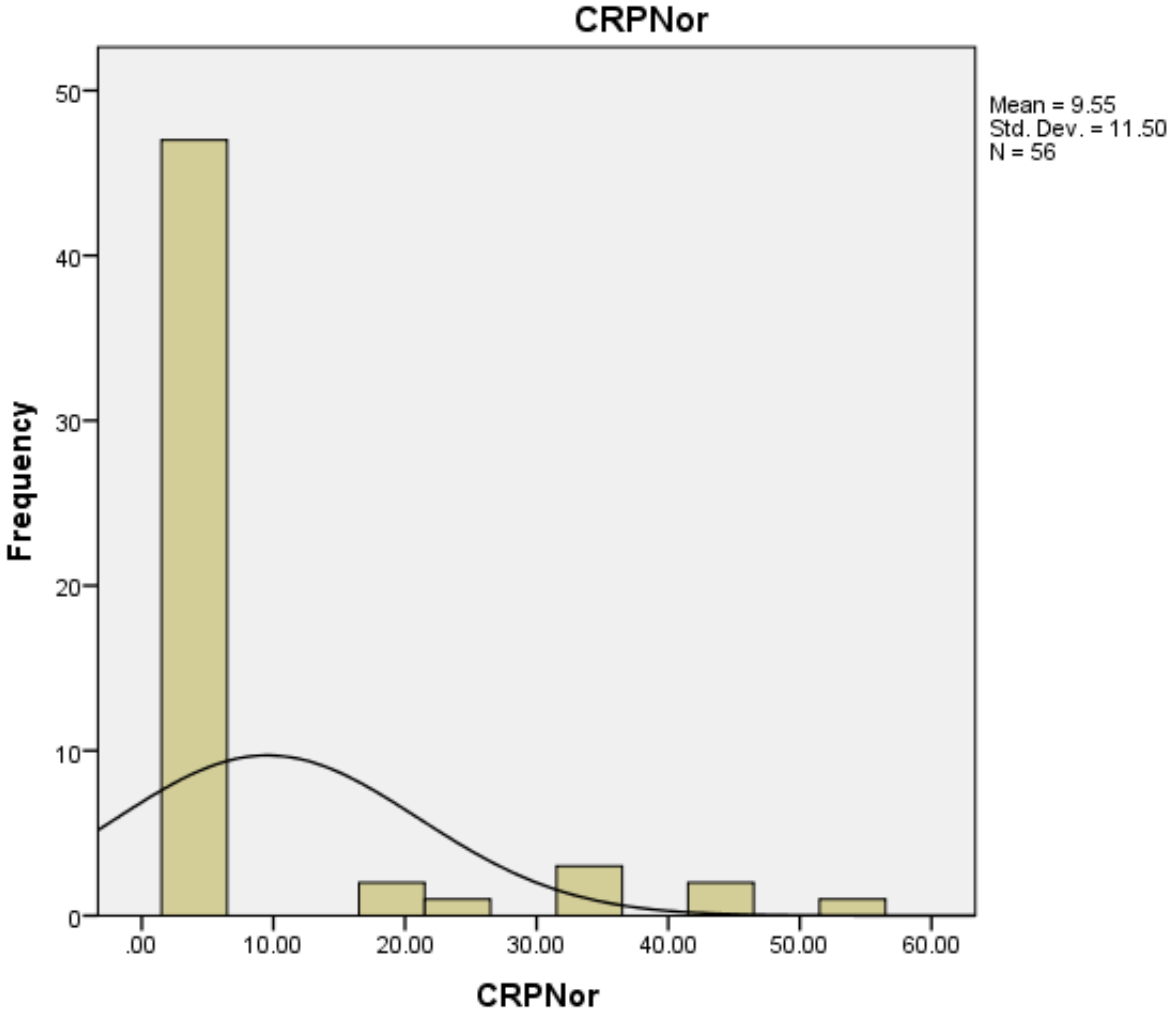


Figure 13: CRP in Normal patients

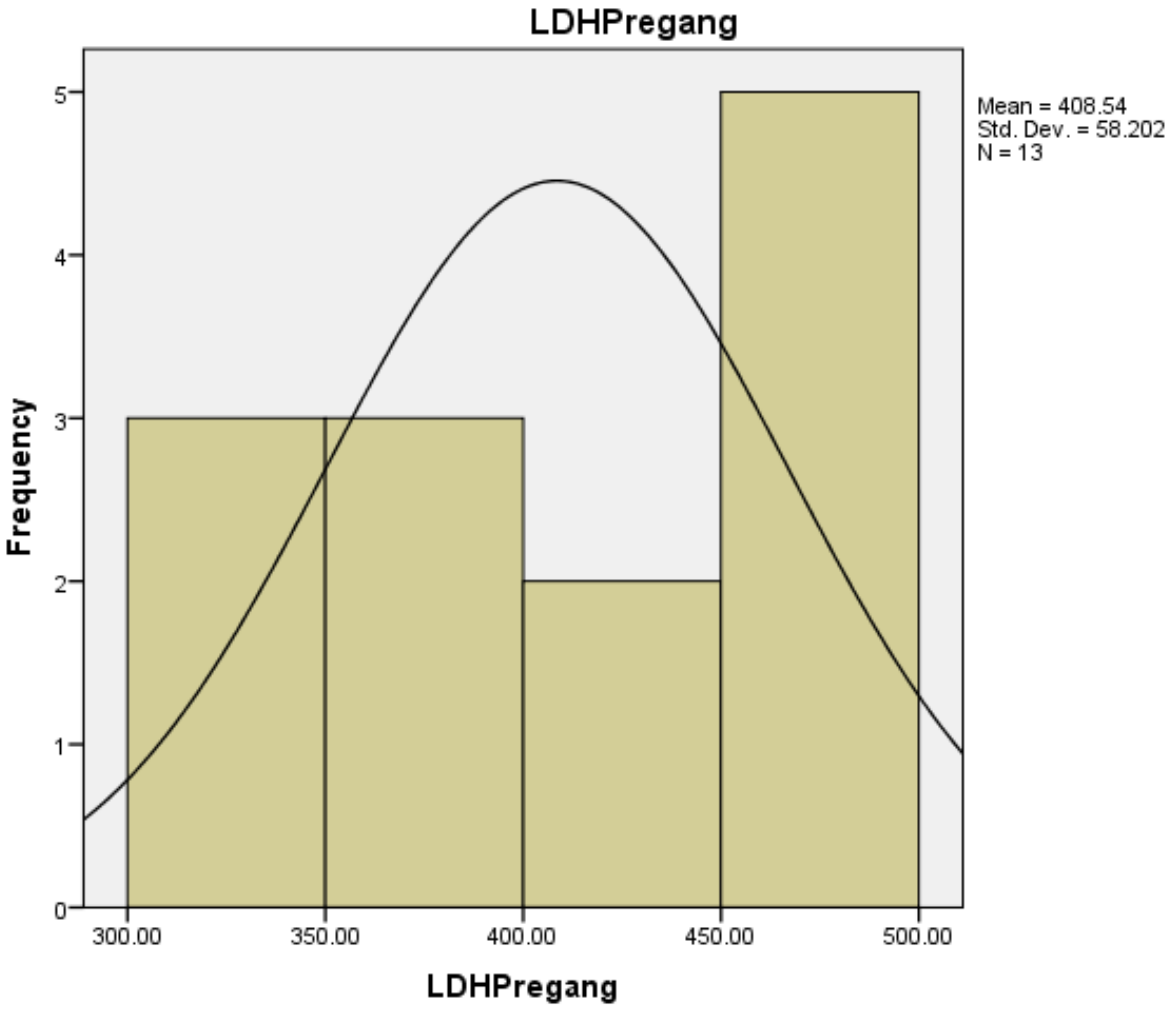


Figure 14: Serum LDH in pregangrene patients

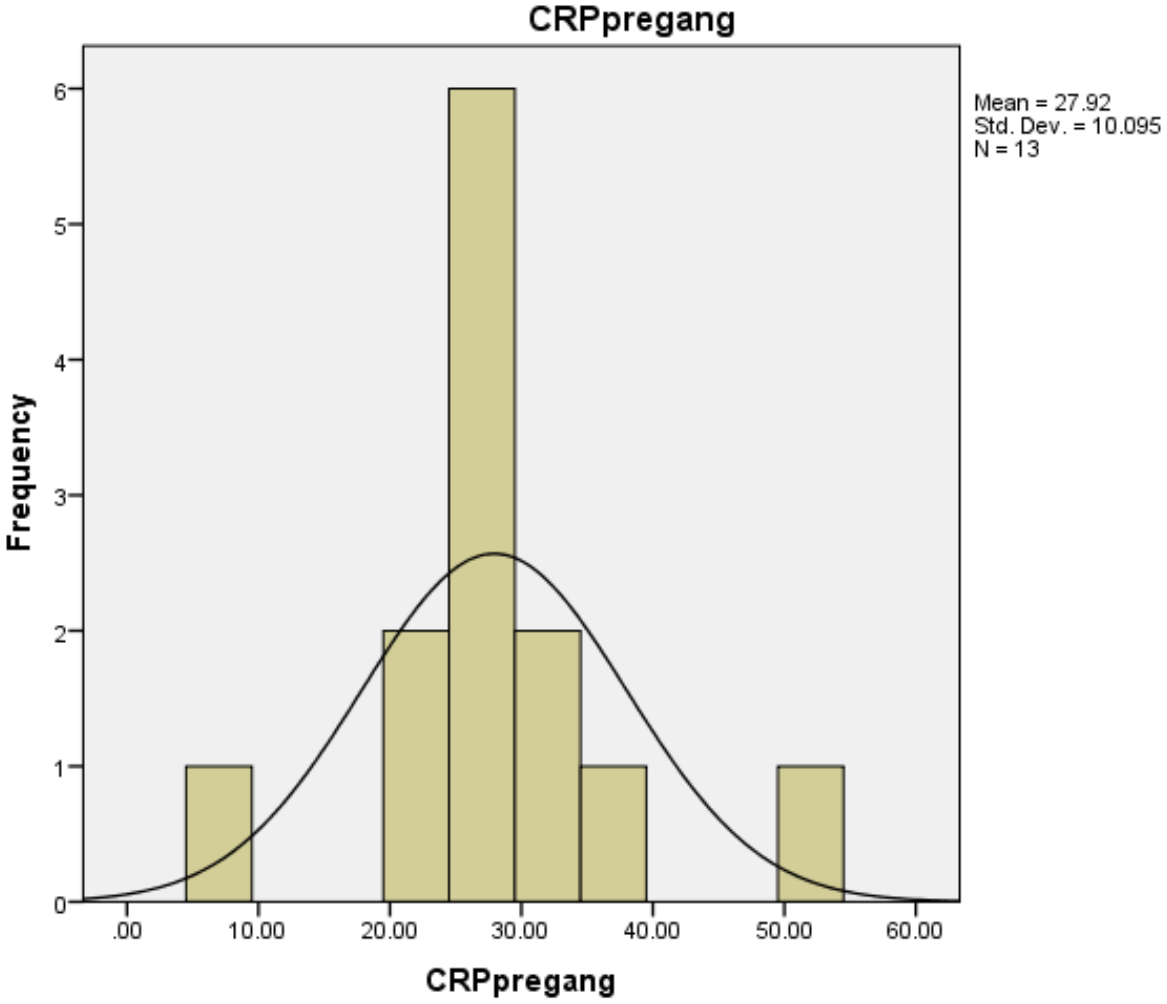


Figure 15: Serum CRP in pregangrene patients

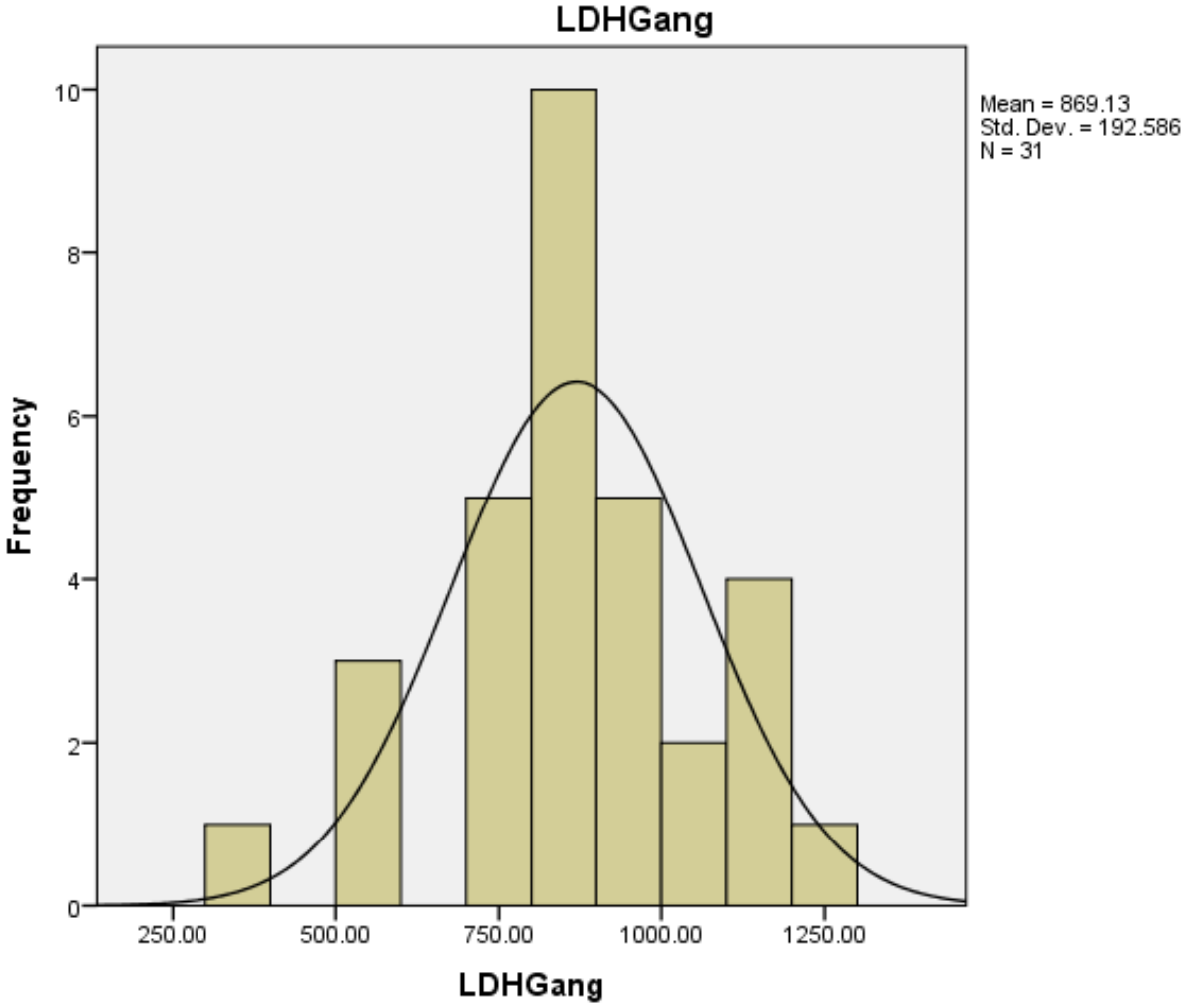


Figure 16: Serum LDH in gangrene patients

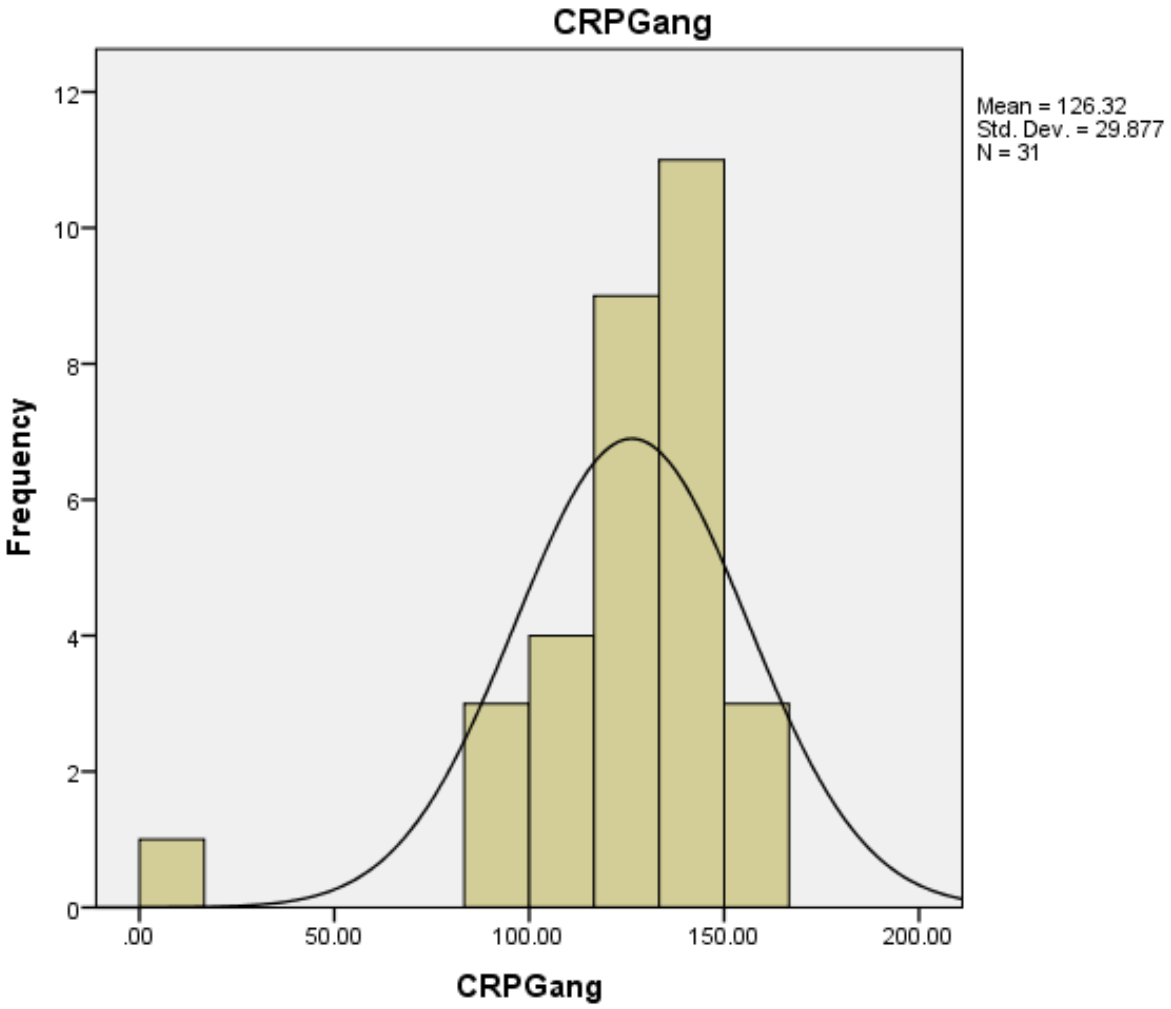


Figure 17: Serum CRP in gangrene patients

Inferential Statistics

The following table shows the mean serum LDH and CRP in the three groups based on the amount of gangrene present. The mean serum LDH was high (mean=869, S.D=192) and serum CRP was high (mean=126, S.D=29.87) in patients with gangrene.

	LDH Normal	CRP Normal	LDH Gangrene	CRP Gangrene	LDH Pregangrene	CRP pregangrene
N	56	56	31	31	13	13
Mean	165.23	9.55	869.12	126.32	408.53	27.92
Median	128.5	5.0	850.0	133.0	426.0	26.0
Std. Deviation	115.3	11.5	192.5	29.8	58.2	10.0
Minimum	102.00	4.00	350.00	4.00	320.00	7.00
Maximum	749.00	52.00	1205.00	164.00	497.00	52.00

Table 3: Mean, Median and Range of the serum LDH and CRP levels.

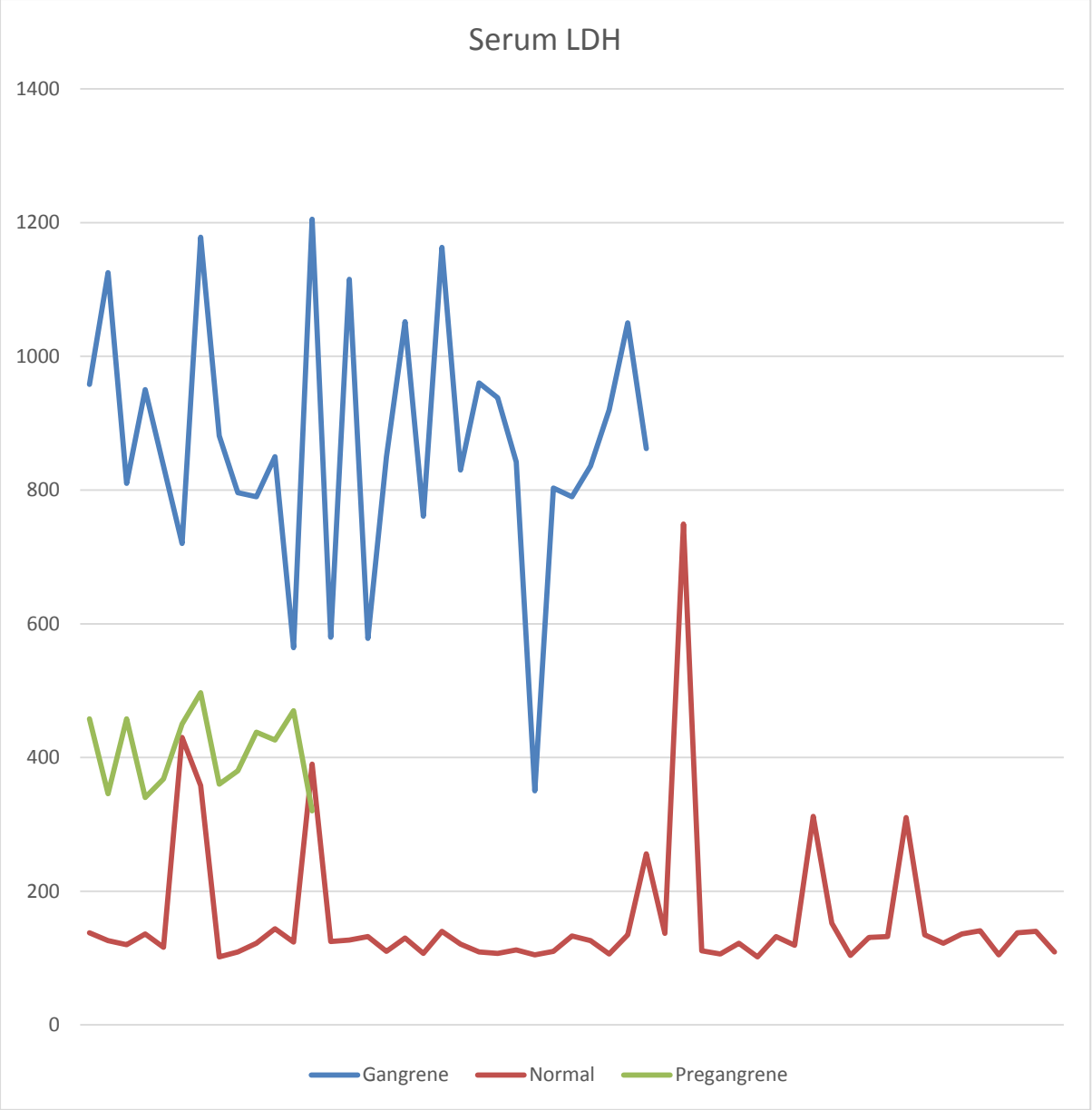


Figure 18: Serum LDH levels in the three groups

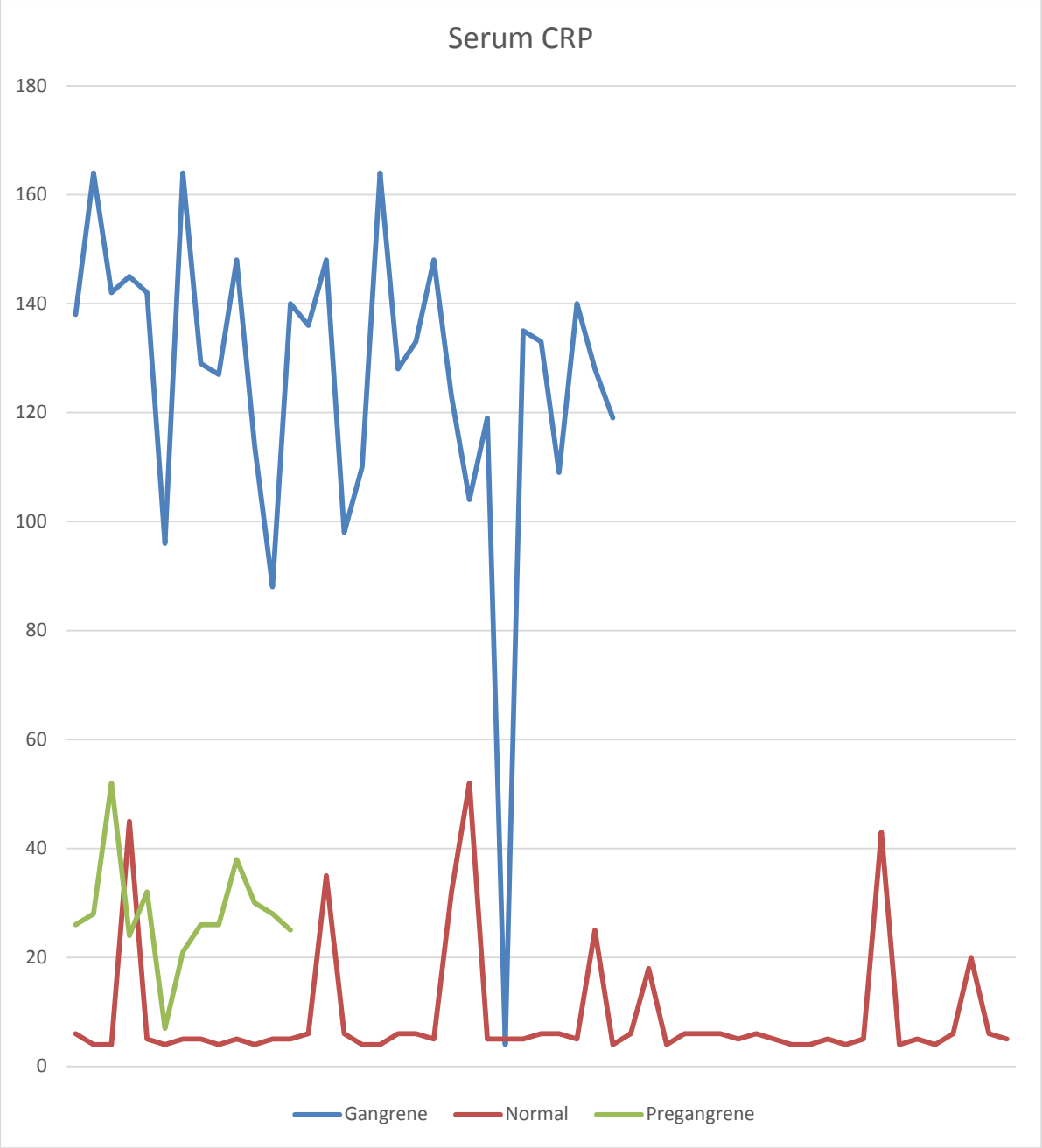


Figure 19: Serum CRP levels in the three groups

Kruskal Wallis Test

Independent Samples Kruskal Wallis Test shows the following results. Table 4 shows the rank of the various groups. Table 5 shows the chi-square value and the significance. P value is less than 0.005, therefore the tests are significant.

Parameter	Group	N	Mean Rank
LDH	Normal	56	29.38
	Gangrene	31	84.39
	Pregangrene	13	60.69
	Total	100	
CRP	Normal	56	30.68
	Gangrene	31	83.03
	Pregangrene	13	58.31
	Total	100	

Table 4: Mean ranks of various groups.

Chi-square value and the significance	LDH	CRP
Chi-Square	73.605	66.911
P value	<0.005	<0.005

Table 5: Chi-square and p-value

Hypothesis testing

The following figure shows the hypothesis test summary. The serum LDH and Serum CRP are useful Biomarkers in Prediction of Bowel Gangrene in Intestinal Obstruction.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of LDH is the same across categories of Gang.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
2	The distribution of CRP is the same across categories of Gang.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Figure 20: Hypothesis test summary

DISCUSSION

DISCUSSION

Discussion

A Prospective Study on Combination of Raised Serum C - reactive protein and D – Lactate as Useful Biomarkers in Prediction of Bowel Gangrene in Intestinal Obstruction included 100 patients presenting with signs of intestinal obstruction and strangulation. All patients presenting with acute intestinal obstruction of were selected, serum CRP & D-lactate were taken pre operatively and their increase were correlated with per operative findings of bowel gangrene.

The age distribution of the patients is given below. The mean age is 51.13 years with a standard deviation of 12.2 years. The majority of the patients were males (n=53, 53%) and the rest were females (n=47, 47%). Abdominal pain was seen in fifty patients (50%) and the rest did not have abdominal pain (n=80, 80%). Irreducible swelling was present in 40% (n=40) of the patients while the remaining (n=60, 60%) did not have irreducible swelling.

The incidence of vomiting in patients was 52% (n=52) while 48% of them (n=48) did not have vomiting. Around 45% (n=45) cases presented with obstipation while the rest did not have obstipation. Abdominal distension was present in 48% (n=48) of the cases while the remaining 52% (n=52) did not have abdominal distension. Guarding was present in 60% (n=60) of the cases while the rest (n=40, 40%) did not have guarding or rigidity.

The patients presenting with bowel sounds were 35% (n=35) while the rest (n=65, 65%) did not have bowel sounds. Majority of them had symptoms for more than 48 hours (n=62, 62%). Around 22% (n=22) of them had symptoms between 24-48 hours while the rest (n=16, 16%) had symptoms for less than 24 hours. Around 81% (n=81) did not have any history of previous surgery. The gangrene of the bowel was present in 31% (n=31) of the cases while the rest were normal (n=56, 56%) or pregangrenous state (n=13, 13%).

The mean serum LDH was high (mean=869, S.D=192) and serum CRP was high (mean=126, S.D=29.87) in patients with gangrene.

One of the commonest surgical emergency in abdominal surgery is acute mechanical bowel obstruction. It is associated with increased morbidity and economic burden to hospitals globally. It is a major reason for admission in the surgical ICU and emergency. Intestinal obstruction is a serious condition that requires rapid identification, diagnosis and treatment. One of the challenges of acute bowel obstruction is the inability to differentiate between simple and complicated acute intestinal obstruction. This is essential to decide if an emergency surgery is required or non-operative procedures are enough.

The decision for the management of acute intestinal obstruction should be made based on the various clinical, laboratory and radiological parameters. Even experienced clinicians with good laboratory and radiological procedures find it challenging to decide the mode of management of acute intestinal obstruction.

Immediate and accurate diagnosis of the obstruction along with the etiology is essential for effective management and good prognosis. The clinical picture, etiology, prevalence of strangulation are not conclusive leading to inconclusive standard method of care.

Strangulation is the gravest outcome of the illness that might require an emergency procedure. Emergency laparotomy being the treatment of choice. Around 7 to 42% of the intestinal obstructions are faced with the complications of strangulation.

Time is golden in the management of acute intestinal strangulation. Earlier is the diagnosis and intervention, better is the prognosis. The diagnosis of strangulation depends on the clinical evaluation and the expertise of the team evaluating the patient.

The serum LDH and Serum CRP are useful Biomarkers in Prediction of Bowel Gangrene in Intestinal Obstruction.

CONCLUSION

CONCLUSIONS

Summary and Conclusions

A Prospective Study on Combination of Raised Serum C - reactive protein and D – Lactate as Useful Biomarkers in Prediction of Bowel Gangrene in Intestinal Obstruction included 100 patients presenting with signs of intestinal obstruction and strangulation.

The mean age is 51.13 years with a standard deviation of 12.2 years. The majority of the patients were males (n=53, 53%) and the rest were females (n=47, 47%).

The gangrene of the bowel was present in 31% (n=31) of the cases while the rest were normal (n=56, 56%) or pregangrenous state (n=13, 13%).

The mean serum LDH was high (mean=869, S.D=192) and serum CRP was high (mean=126, S.D=29.87) in patients with gangrene.

The decision for the management of acute intestinal obstruction should be made based on the various clinical, laboratory and radiological parameters.

Immediate and accurate diagnosis of the obstruction along with the etiology is essential for effective management and good prognosis.

The clinical picture, etiology, prevalence of strangulation are not conclusive leading to inconclusive standard method of care.

Strangulation is the gravest outcome of the illness that might require an emergency procedure. Time is golden in the management of acute intestinal strangulation. Earlier is the diagnosis and intervention, better is the prognosis. The diagnosis of strangulation depends on the clinical evaluation and the expertise of the team evaluating the patient.

The serum LDH and Serum CRP are useful Biomarkers in Prediction of Bowel Gangrene in Intestinal Obstruction.

LIMITATIONS

LIMITATIONS

1) The study sample size was small which may lead to non-generalizability of the results
2) The study does not have a randomised design which reduces the validity of the methodology used in this study
3) Since all the patients were admitted in emergency, the role of other co-morbid conditions in the prognosis of the disease remains a question.
4) The long term results were not computed due to resource limitations.

FUTURE RECOMMENDATIONS

FUTURE RECOMMENDATIONS

1) Studies should be done with a larger sample size
2) Multicenter studies should be preferred
3) Long term follow up is recommended
4) Randomised Control Trials should be encouraged to understand the efficacy of biomarkers

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ANNEXURES

PATIENT CONSENT FORM

STUDY TITLE:

"A PROSPECTIVE STUDY ON COMBINATION OF RAISED SERUM C-REACTIVE PROTIEN AND D – LACTATE AS USEFUL BIOMARKERS IN PREDICTION OF BOWEL GANGRENE IN INTESTINAL OBSTRUCTION

Department of General surgery, GMKMCH

PARTICIPANT NAME: AGE : SEX: I.P. NO :

I confirm that I have understood the purpose of surgical/invasive procedure for the above study. I have the opportunity to ask the question and all my questions and doubts have been answered to my satisfaction.

I have been explained about the possible complications that may occur during and after medical/ surgical procedure. I understand that my participation in the study is voluntary and that I am free to withdraw at any time without giving any reason.

I understand that investigator, regulatory authorities and the ethics committee will not need my permission to look at my health records both in respect to the current study and any further research that may be conducted in relation to it, even if I withdraw from the study. I understand that my identity will not be revealed in any information released to third parties or published, unless as required under the law. I agree not to restrict the use of any data or results that arise from the study.

I hereby consent to participate in this study for various surgical/invasive procedures and their outcomes.

Time:

Date: Signature / Thumb Impression of Patient

Place:

Patient's name:

Signature of the investigator: _____

Name of the investigator: _____

PROFORMA

A CASE OF INTESTINAL OBSTRUCTION

Name:

Address:

Age/sex:

Religion:

O.P No:

I.P No:

D.O.A:

Date of surgery:

D.O.D:

CHIEF COMPLAINTS:

Duration of symptoms:

Past History:

- DM
- HTN
- TB
- Epilepsy
- Previous Surgery
- Jaundice
- Cirrhosis
- Thyroid Disorders

Personal History:

- Smoker
- Alcoholism
- Diet
- Life Style

INITIAL ASSESSMENT OF PATIENT:

1.Vitals:

- Pulse :
- BP :
- RR :
- Temperature :

2.General Signs:

- Pallor :
- Tongue :
- Skin :
- Icterus :
- Cyanosis :
- Lymphadenopathy :

SYSTEMIC EXAMINATION:

- CVS
- RS
- CNS

EXAMINATION OF ABDOMEN:

INSPECTION:

PALPATION:

PERCUSSION:

AUSCULTATION:

EXTERNAL GENITALIA:

PER RECTAL EXAMINATION:

CLINICAL DIAGNOSIS:

INVESTIGATIONS:

- Hb%
- Total Counts
- Differential Counts
- ESR
- Platelets
- PCV
- Grouping & Typing
- BT/CT
- HIV
- HBsAg
- HCV
- ECG
- Urine:
  - Albumin
  - Sugar
- Blood:
  - Rbs
  - Blood Urea

- Ser.Creatinine
- Ser.Sodium
- Ser.Potassium

- **Serum C-reactive Protien:**
- **Serum Lactate Dehydrogenase:**
- **CHEST X RAY**
- **X RAY ABDOMEN ERECT;**
- **ABDOMEN AND PELVIS USG**
- **CECT ABDOMEN**

- Pre-operative Diagnosis:
- Operative Procedure:
- Anaesthesia:
- Incision:
- Surgical Procedure:

- Intra Operative Findings:

- Per Operative Finding Of Bowel Gangrene: Yes/No

THE KEY TO MASTER CHART

M – Male

F – Female

LDH – Serum D-Lactate Levels

CRP – C- Reactive Protein

AIO – Adhesive Intestinal Obstruction

CAC – Carcinoma Colon

INH – Internal Hernia

INTS – Intussusception

OFH – Obstructed Femoral Hernia

OIH – Obstructed Inguinal Hernia

PCB – Post operative Contraction Band

SVL – Sigmoid Volvulus

URBO – Uremic Bowel Obstruction

\+ - Present

\- - Absent

+- - Sluggish

MASTER CHART

S.NO	AGE	SEX	IP NO.	PREVIOUS H/O SURGERY	ABD PAIN	IRREDUCIBLE SWELING	DURATION	VOMITING	OBSTIPATION	ABDOMINAL DISTENSION	GAURDING/ RIGIDITY	BOWEL SOUNDS	ETIOLOGY	SE.LDH	CRP	BOWEL GANGRENE	PRE GANGRENOUS - BOWEL VIABLE	BOWEL NORMAL
1	45	M	3245	NIL	+	+	>48HRS	+	+	-	+	-	OIH	958	138	+		
2	36	M	4523	NIL	-	+	>24HRS	-	-	-	-	+-	OIH	138	6	-		+
3	29	F	1782	NIL	+	-	>24HRS	-	-	+	+	+	AIO	126	4	-		+
4	43	M	1523	NIL	+	-	>48HRS	+	+	+	+	-	SVL	1125	164	+		
5	56	F	2758	APPENDICECTOMY & HYSTRECTOMY	+	-	<24HRS	+	-	+	+	+-	PCB	458	26	-	+	
6	35	F	2701	NIL	+	+	>48HRS	-	-	-	-	+	OFH	120	4	-		+
7	39	M	3928	NIL	+	+	>48HRS	+	+	-	+	-+	OIH	810	142	+		
8	72	M	2394	NIL	+	-	>48HRS	+	-	+	+	+-	URBO	136	45	-		+
9	48	M	2732	LAPARATOMY - PERFORATION	+	-	<24 HRS	+	-	-	-	-+	PCB	116	5	-		+
10	46	F	6752	NIL	-	+	>48hrs	+	+	-	+	+-	OFH	950	145	+		
11	31	M	3354	NIL	+	+	>48HRS	-	-	-	-	+	OIH	430	4	-		+
12	61	F	4375	NIL	+	-	>24HRS	+	+	+	+	-	AIO	358	5	-		+
13	48	F	2965	NIL	+	+	>48HRS	-	-	-	-	+	OFH	102	5	-		+
14	74	M	10122	NIL	+	+	>48HRS	-	-	-	-	+	OIH	346	28	-	+	
15	57	M	5396	REPEATED LAPARATOMY - ADHESIOLYSIS	+	-	>48HRS	+	+	+	+	-	PCB	836	142	+		
16	49	F	3571	NIL	+	-	>48HRS	+	+	+	+	-	SVL	720	96	+		
17	29	F	3468	NIL	+	+	>48HRS	+	-	-	-	+	OFH	109	4	-		+
18	53	M	3504	NIL	+	+	>48HRS	+	+	-	-	+	OIH	458	52	-	+	
19	59	F	3022	NIL	-	-	>24HRS	+	-	-	+	+-	INTS	340	24	-	+	
20	63	F	2903	HYSTERECTOMY	+	-	<24 HRS	-	-	+	+	+	PCB	122	5	-		+
21	50	M	2732	NIL	+	-	>24HRS	+	+	+	+	+-	INH	1178	164	+		
22	43	M	5306	NIL	+	+	>48HRS	-	-	-	-	+	OIH	144	4	-		+
23	65	M	5174	NIL	+	-	>48HRS	+	+	+	+	-	AIO	881	129	+		
24	73	F	4121	NIL	-	-	>48HRS	+	+	+	+	-	CAC	796	127	+		
25	29	M	4167	NIL	-	+	>24HRS	+	-	-	-	+	OIH	124	5	-		+
26	57	F	8287	UMBLICAL HERNIA REPAIR	+	-	<24 HRS	-	-	+	+	+-	PCB	390	5	-		+
27	65	F	5590	LAPARATOMY-OBSTRUCTION	+	-	<24 HRS	+	-	+	+	-	PCB	125	6	-		+
28	43	M	2811	NIL	+	+	>48HRS	-	+	-	+	+	OIH	790	148	+		
29	65	M	10632	NIL	+	-	>24HRS	+	-	+	+	-	URBO	127	35	-		+
30	41	M	4407	NIL	+	-	>48HRS	+	+	+	+	-	AIO	850	114	+		
31	47	F	3184	LAPARATOMY-TUMOUR EXCISION	+	-	<24 HRS	-	-	+	+	+-	PCB	132	6	-		+
32	57	F	2869	NIL	+	-	>48HRS	+	+	+	+	-	AIO	564	88	+		
33	62	M	3438	NIL	+	+	>48HRS	+	-	-	-	+	OIH	110	4	-		+
34	53	F	5923	NIL	+	-	<24 HRS	+	-	+	+	+-	INTS	130	4	-		+
35	50	M	4567	NIL	-	+	>48HRS	-	-	-	+	+	OIH	107	6	-		+
36	45	F	4389	NIL	+	-	>48HRS	-	+	+	+	-	SVL	1205	140	+		
37	59	M	2567	LAPARATOMY - PERFORATION	+	-	<24 HRS	-	+	+	+	-	PCB	580	136	+		
38	39	F	8726	NIL	+	+	>48HRS	-	-	-	-	+	OFH	368	32	-	+	
39	28	M	3657	NIL	+	-	>24HRS	+	+	+	+	-	AIO	140	6	-		+
40	30	F	4412	NIL	+	+	>48HRS	-	-	-	-	+	OIH	121	5	-		+
41	65	M	3321	APPENDICECTOMY	+	-	>48HRS	+	-	-	+	-	CAC	109	32	-		+
42	54	F	5278	NIL	+	-	>24HRS	+	+	+	+	+-	INH	1115	148	+		
43	48	F	9871	NIL	+	-	>48HRS	+	+	+	+	-	SVL	450	7	-	+	
44	53	M	3345	NIL	-	+	>48HRS	-	+	-	+	+	OIH	578	98	+		

S.NO	AGE	SEX	IP NO.	PREVIOUS H/O SURGERY	ABD PAIN	IRREDUCIBLE SWELING	DURATION	VOMITING	OBSTIPATION	ABDOMINAL DISTENSION	GAURDING/ RIGIDITY	BOWEL SOUNDS	ETIOLOGY	SE.LDH	CRP	BOWEL GANGRENE	PRE GANGRENOUS - BOWEL VIABLE	BOWEL NORMAL
45	61	M	3256	NIL	+	+	>48HRS	-	-	-	-	+	OIH	497	21	-	+	
46	63	M	5647	NIL	+	-	>24HRS	-	-	+	-	+	URBO	107	52	-		+
47	60	F	1654	NIL	+	-	>24HRS	+	-	+	+	+	AIO	112	5	-		+
48	49	M	1872	NIL	+	-	>48HRS	+	+	-	+	+-	INTS	850	110	+		
49	50	F	2453	LAPARATOMY - PERFORATION	+	-	>48HRS	-	+	+	+	+-	PCB	1052	164	+		
50	62	F	6477	NIL	-	-	>48HRS	+	-	-	-	+	CAC	140	4	-		
51	56	M	8865	APPENDICECTOMY	+	-	>24HRS	+	-	+	+	-	AIO	105	5	-		+
52	34	M	2347	NIL	+	-	>48HRS	-	+	+	+	-	SVL	360	26	-	+	
53	57	F	8543	NIL	-	-	>48HRS	+	-	-	+	+-	INTS	110	5	-		+
54	49	M	4652	NIL	+	+	>48HRS	-	+	-	+	-	OIH	761	128	+		
55	56	M	1234	LAPARATOMY - PERFORATION	+	-	<24 HRS	-	--	+	-	+-	PCB	133	6	-		+
56	46	F	9064	NIL	-	+	>48HRS	+	+	-	-	-	OFH	1163	133	+		
57	76	F	8012	NIL	+	-	>48HRS	-	-	-	-	+-	CAC	126	6	-		+
58	65	F	7406	NIL	+	-	>48HRS	+	+	+	+	-	CAC	830	148	+		
59	46	M	5540	NIL	+	-	>48HRS	-	+	+	+	-	AIO	960	123	+		
60	35	M	8471	NIL	-	+	>24HRS	-	-	-	-	+	OIH	106	5	-		+
61	66	F	6609	NIL	+	-	>48HRS	+	-	-	+	+-	CAC	135	25	-		+
62	36	M	3078	NIL	+	-	>48HRS	+	+	+	+	-	SVL	256	4	-		+
63	28	F	5125	NIL	+	+	>48HRS	+	-	-	-	+	OFH	380	26	-	+	-
64	48	M	9341	NIL	-	-	>24HRS	+	-	+	+	-	AIO	137	6	-		+
65	59	F	8657	APPENDICECTOMY	+	-	>48HRS	-	+	-	+	+-	CAC	749	18	-		+
66	55	M	10293	NIL	+	+	>24HRS	-	-	-	-	+	OIH	111	4	-		+
67	48	F	3425	NIL	+	-	>48HRS	+	+	+	+	-	SVL	938	104	+		
68	43	F	4320	NIL	+	+	>48HRS	-	-	-	-	+	OFH	106	6	-		+
69	40	M	7098	NIL	+	-	>24HRS	+	+	+	+	-	AIO	122	6	-		+
70	35	M	5120	NIL	-	-	>24HRS	+	-	+	+	-	AIO	438	38	-	+	
71	73	M	3467	NIL	+	-	>48HRS	-	+	-	-	+-	CAC	842	119	+		
72	64	F	53091	NIL	+	+	>48HRS	-	+	-	-	-+	OFH	102	6	-		+
73	49	M	10986	NIL	+	+	>48HRS	+	+	-	-	+	OIH	350	4	+		
74	53	F	3208	LAPARATOMY - TUMOUR EXCISION	+	-	<24 HRS	-	-	+	+	+-	PCB	132	5	-		+
75	73	M	4309	UMBLICAL HERNIA REPAIR	+	-	<24 HRS	+	-	+	+	+	PCB	119	6	-		+
76	67	F	7650	NIL	-	-	>48HRS	-	+	-	-	-	CAC	803	135	+		
77	45	M	2479	NIL	+	-	<24 HRS	+	-	+	+	-	AIO	312	5	-		+
78	60	F	7823	NIL	+	-	>48HRS	+	+	+	+	-	SVL	152	4	-		+
79	54	M	54123	NIL	-	+	>48HRS	-	+	-	-	-	OIH	790	133	+		
80	50	M	9011	NIL	+	-	>24HRS	+	-	-	+	-	INTS	426	30	-	+	
81	38	F	9568	NIL	+	+	>24HRS	-	-	-	-	+	OFH	104	4	-		+
82	60	M	20971	NIL	+	+	>48HRS	-	-	-	-	+	OIH	464	32	-		
83	40	M	38701	LAPARATOMY - OBSTRUCTION	+	-	<24 HRS	-	-	+	+	-	PCB	131	5	-		+
84	54	F	12386	NIL	+	+	>48HRS	-	+	-	-	-	OFH	836	109	+		
85	43	F	20941	NIL	+	-	>48HRS	-	+	+	+	-	SVL	132	4	-		+
86	50	M	61250	NIL	-	+	>24HRS	-	-	-	-	+	OIH	310	5	-		+
87	65	F	4664	HYSTERECTOMY	+	-	<24 HRS	-	+	+	+	-	PCB	920	140	+		
88	70	M	9607	NIL	+	-	>48HRS	+	-	-	+	-	CAC	135	43	-		+
89	59	F	3201	NIL	+	+	>48HRS	-	-	-	-	+	OFH	122	4	-		+
90	38	M	10345	NIL	-	+	>48HRS	-	-	-	-	+	OIH	470	28	-	+	-
91	48	F	7854	HYSTERECTOMY	+	-	<24 HRS	-	-	+	+	+	PCB	136	5	-		+

S.NO	AGE	SEX	IP NO.	PREVIOUS H/O SURGERY	ABD PAIN	IRREDUCIBLE SWELING	DURATION	VOMITING	OBSTIPATION	ABDOMINAL DISTENSION	GAURDING/ RIGIDITY	BOWEL SOUNDS	ETIOLOGY	SE.LDH	CRP	BOWEL GANGRENE	PRE GANGRENOUS - BOWEL VIABLE	BOWEL NORMAL
92	43	F	1226	NIL	-	+	>48HRS	+	+	+	-	-	OFH	1050	128	+		
93	52	M	6753	NIL	+	+	>24HRS	-	-	-	-	+	OIH	141	4	-		+
94	58	M	58932	NIL	-	+	>48HRS	+	-	-	-	+	OIH	105	6	-		+
95	38	F	56768	NIL	+	-	>48HRS	+	+	+	+	-	SVL	198	4	-		
96	28	F	2235	NIL	-	-	>24HRS	-	+	-	+	-	URBO	138	20	-		+
97	68	M	4587	NIL	+	+	>48HRS	+	-	-	-	+	OIH	140	6	-		+
98	65	M	5886	LAPARATOMY - TUMOUR EXCISION	+	-	<24 HRS	-	+	+	+	-	PCB	320	25	-	+	-
99	35	M	6445	NIL	+	+	>48HRS	-	-	-	-	+	OIH	109	5	-		+
100	56	F	1267	NIL	+	+	>48HRS	+	+	+	-	-	OFH	862	119	+		