

D-Lactate as Predictive Tool for Assessing Bowel Gangrene in Patients Admitted with Acute Intestinal Obstruction in Surgical Wards of Government Medical College Thiruvananthapuram

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Abstract: Introduction: Intestinal obstruction is one of the commonest clinical problems encountered in surgical practice. One of the grave complications of intestinal obstruction is strangulation and subsequent bowel gangrene. Which requires an emergency laparotomy for management. Bowel ischemia may arise from a number of causes affecting the arterial and venous compartments of the mesenteric circulation. The rapid onset of ischemia and the potential rapidity with which bowel infarction may occur explain the lethality of this disease. Ischemia, which complicate 7% to 42% of bowel obstruction, significantly increase mortality associated with bowel obstruction. Bowel gangrene is a major abdominal catastrophe associated with high mortality rate. This increased mortality is attributed to difficulty in diagnosing the condition early, the late presentation of the patient to the hospital and non - availability of précised diagnostic tool for assessing bowel gangrene. This study was conducted to emphasis the significance of early estimation of rise in D - lactate levels in patients with intestinal obstruction. Objective: To study the diagnostic accuracy of D - lactate as predictive tool for assessing bowel gangrene in patients admitted with acute intestinal obstruction in surgical wards of Govt. Medical College, Thiruvananthapuram. Methodology: Design: Diagnostic Test Evaluation. Study Population: Inpatients at Department of General Surgery. Sampling: Consecutive Sampling. Subjects: All Patients (Age > 18 yrs) admitted with features of acute intestinal obstruction in general surgery wards of MCH, Thiruvananthapuram. Sample size: 125 Subjects. Data Collection and analysis: Data will be entered in excel sheets and analyzed using appropriate statistical software. All quantitative variables will be expressed as mean and standard deviation and all qualitative variables will be expressed as proportion. Receiver operating characteristic (ROC) curve will be drawn and cutoff values for the serum D - lactate will be calculate. Sensitivity, specificity, positive predictive values (PPVs), and negative predictive values (NPVs) will be calculated. Results: The study sample consisted of 125 persons. With 87 males (69.6%) and 38 females (30.4%). the age distribution is between 40 to 80 yrs., and most patients being the age group of ≤ 50 (29.6%). most patients have duration of pain >24 hrs. (68.8%). vomiting, obstipation generalized abdominal distention and abdominal pain are more frequent symptoms with significant history of previous abdominal surgery (31.2%). shock is associated with most of bowel gangrene cases (84.2%). exaggeration of bowel sounds is more common in simple bowel obstruction. It is found that significant abdominal tenderness and guarding /rigidity will be there in intestinal obstruction with bowel gangrene. In this study results ROC curve with AUC =0.891, when cut off value of serum lactate taken as 5 mmol/L, sensitivity of 85.71%, specificity of 88.89, PPV of 75% and NPV of 94.1% respectively. Conclusion: Intestinal obstruction is one of the commonest clinical problems encountered in surgical practice. One of the grave complications of intestinal obstruction is strangulation and subsequent bowel gangrene. Serum D - lactate can be useful and reasonable markers for predicting strangulation and bowel gangrene in cases of acute intestinal obstruction in an emergency setting. From the results of this study there is statistically significant relation between the serum lactate value and bowel gangrene. Higher the value serum lactate there is more chance of non - viability of bowel.

Keywords: D - lactate, Strangulation, Bowel, Gangrene, Ischemia, Markers

1. Introduction

Intestinal obstruction is one of the commonest clinical problems encountered in surgical practice. One of the grave complications of intestinal obstruction is strangulation and subsequent gangrene, which requires an emergency laparotomy for management. Ischemia, which complicates 7 to 42% of bowel obstructions, significantly increases mortality associated with bowel obstruction.

Intestinal obstruction is a syndrome characterized by a blockage of the intestinal content, gas and liquid, through small or large bowel. The block must be complete and permanent. The etiology based on a large number of factors that allow the subdivision into mechanical and functional/paralytic obstruction. The other feature characterizes the syndrome: the seat of the obstruction along the bowel—upper small gut, distal small gut, and large bowel.

Finally, the cause of obstruction can involve the vascular supply of an intestinal segment, giving rise to strangulation obstruction and lead to gangrene, that should be differentiated from simple obstruction. The syndrome of intestinal obstruction with these various etiopathological and clinical features develops the same, overlap able, and pathophysiological alterations.

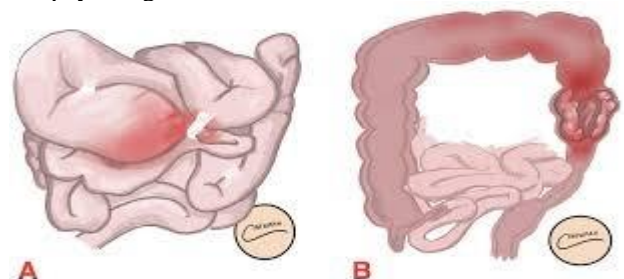


Figure 1: Bowel Obstruction

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Etiology

Bowel obstruction can be caused by several factors. The causes of mechanical obstruction can be divided into causes within the bowel lumen, causes in the intestinal wall, and extrinsic causes. The causes within the bowel are infrequent. They can be due to large gallstones passed into the intestinal lumen by spontaneous bilio - digestive fistulas, most frequently cholecystoduodenal fistulas, very rarely phytobezoar, masses of parasites, food bolus, concretions of barium following barium enema X - ray investigation or X - ray studies with opaque medium. It is useful to point out that the fecaloma, fecal impaction in the rectal ampulla, based on the damage of the autonomic nervous system in the colorectal wall, can cause chronic alteration of intestinal transit with incomplete obstruction without the pathophysiological alterations of acute gut obstruction. The causes in the gut wall include the neoplasms of small and large bowel, congenital atresia, stenosis due to chronic inflammatory disease (Crohn's disease, diverticulitis, etc.), and post anastomotic or posttraumatic strictures. The extrinsic causes include a very large range of pathological conditions: compression by external masses, adhesions, bands, strangulated external or internal hernias, volvulus, and intussusception. The acute intestinal obstruction, simple or strangulated forms, is characterized by complete and permanent blockage and consequently the acute pathophysiological syndrome of obstruction may develop with all clinical, laboratory, and instrumental features of bowel. Complications like bowel dilatation, disturbances of fluids and electrolytes balance, congestion, and ischemic parietal damage, etc. On the contrary, in the chronic obstruction, the blockage of gut transit is incomplete and the syndrome cannot develop completely and is characterized only by constipation.

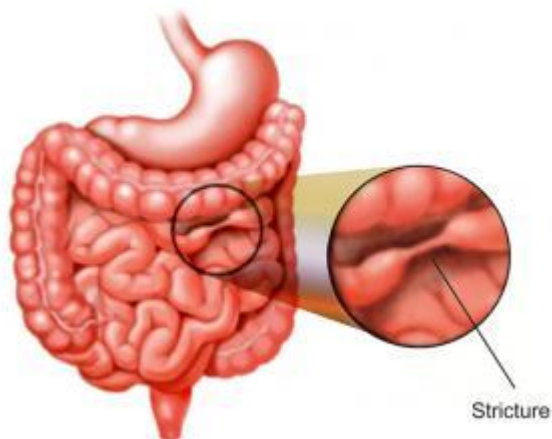


Figure 2: Intestinal obstruction due to stricture

Classification of intestinal obstruction

Intestinal obstruction may be mechanical or paralytic. Mechanical obstruction can be due to intraluminal, intrinsic to the intestinal wall and extrinsic. Paralytic ileus due to reduction or the absence of peristalsis can be caused by peritoneal phlogosis, infection, abdominal surgery, pelvic surgery, and some medications such as antidepressants, pain medications, muscle and nerve disorders, and retroperitoneal hemorrhage. The majority of patients have simple obstruction. On the contrary, there is also strangulation obstruction, usually due to complicated external hernia

(abdominal wall) or internal (by congenital defects or postoperative adhesions) in these patients the vascular supply to strangulated intestinal segment is compromised and consequently intestinal infarction and bowel gangrene. Strangulation obstruction leads to an increased risk of morbidity and mortality. In the mechanical occlusion with strangulation, the vascular (arterial and venous) occlusion leads to bowel ischemia and necrosis. The evolution of strangulated gangrenous bowel is the perforation and peritonitis. The occlusive syndrome becomes worse due to strangulation. Intestinal pseudo - obstruction is a syndrome characterized by a complete dilatation generally of large bowel without mechanical obstacle. The intestinal pseudo - obstruction can affect small or large bowel and it may be possible to differentiate the syndromes with acute or chronic onset and evolution. The chronic pseudo - obstruction can be idiopathic or secondary to systemic disease.



Figure 3: Gangrenous Bowel

Pathophysiology

The obstruction could be simple, closed loop, strangulated. In simple obstruction above the obstruction peristalsis increases, intestine dilates, reduction in peristaltic strength, flaccidity and paralysis (protective but late). And below the obstruction normal peristalsis & absorption until it becomes empty it contracts & becomes immobile. Distention of the intestine is caused by accumulation of gas and fluids. Gas in the intestine is due to swallowed air, bacterial overgrowth and diffusion from blood. Fluids come from the ingested fluids, saliva, gastric and intestinal juice and bile & pancreatic secretions. Dehydration caused by reduced intake, reduced absorption, increased loss (vomiting & sequestration). Systemic effects of obstruction are water and electrolyte losses (lead to hypovolemia), toxic materials and toxemia (lead to sepsis), cardiopulmonary dysfunction (atelectasis), renal failure, shock and death. Strangulation leads to impaired venous return, increased congestion, free peritoneal fluid, edema of intestinal wall, blood in the lumen, impaired arterial blood supply, ischemia and gangrene.

Strangulating obstruction is obstruction with compromised blood flow. It occurs in nearly 25% of patients with small - bowel obstruction. It is usually associated with hernia, volvulus, and intussusceptions. Strangulating obstruction can progress to infarction and gangrene in as little as 6 h. Venous obstruction occurs first, followed by arterial occlusion, resulting in rapid ischemia of the bowel wall. The ischemic bowel becomes edematous and infarcts, leading to gangrene and perforation. In large - bowel obstruction, strangulation is rare (except with volvulus). Closed loop obstruction is a specific type of obstruction in which two points along the course of a bowel are obstructed at a single location thus

forming a closed loop. Usually this is due to adhesions, a twist of the mesentery or internal herniation. In the large bowel it is known as a volvulus. In the small bowel it is simply known

as small bowel closed loop obstruction. Obstruction to the blood supply occur either from the same mechanism which caused obstruction or by the twist of the bowel on mesentery.

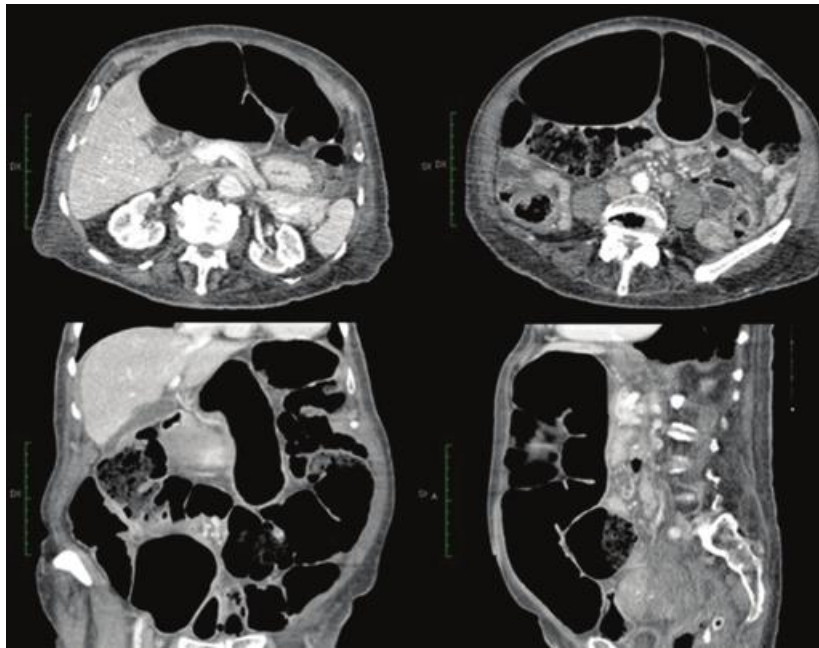


Figure 4: CT scan: sigmoid volvulus.

Majority cases of intestinal obstructions have to be treated with urgent surgery. Various types of surgical procedures have been employed based on intraoperative pathological findings. They should be useful to underline that the choice of the urgent treatment allowed the resolution of majority of adhesion - related obstructions and small bowel volvulus with the surgical procedure of adhesiolysis and intestinal derotation. The intestinal resection has been performed in cases with bowel gangrene. Ogilvie's syndrome required cecostomy. Colorectal malignancies have been treated with primary tumors resection and delayed intestinal anastomosis.

Time is an essence, with an earlier diagnosis of strangulation favoring increased patient's survival. The diagnosis of strangulation is primarily clinical, with a sudden onset of pain, i. e., continuous rather than colicky, the early appearance of shock, and the presence of fever, tachycardia, marked abdominal tenderness, guarding, rebound tenderness, and a tender abdominal mass are all in favor of the diagnosis of strangulation and which may further lead to gangrene. Various biochemical markers, such as values of 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, isoenzymes of lactate dehydrogenase, procalcitonin, alkaline liver phosphatase, and urinary phosphate have been studied in cases of intestinal obstruction and/or intestinal ischemia/strangulation mainly in animal models or tissues with few in clinical settings, with relatively few studies in humans on finding a biomarker of preoperative strangulation. Therefore, studies investigating the role of biomarker in predicting strangulation and gangrene in patients of acute bowel obstruction are needed. Lactic acid is the normal endpoint of the anaerobic breakdown of glucose in the tissues. Lactic acid exists in two optical isomeric forms, L - lactate and D - lactate. D - lactate is not produced in

mammalian tissue, but it is detected in a situation of an abnormal proliferation of enteral bacterial flora due to mucosal injury following mesenteric ischemia. The aim of this study is to assess the diagnostic accuracy of D - Lactate for predicting bowel gangrene in acute intestinal obstruction.

2. Objective

To study the diagnostic accuracy of D - lactate as predictive tool for assessing bowel gangrene in patients admitted with acute intestinal obstruction in surgical wards of Government Medical College, Thiruvananthapuram.

3. Background and Review of Literature

Strangulation of bowel which lead to gangrene is a complication associated with acute intestinal obstruction and requires prompt diagnosis. This is easier said than done, especially in an emergency setting. Moreover, reported mortality rates after acute intestinal obstruction have found association with delay in surgical management with progression to strangulation and gangrene in many cases. Serum D - lactate, is the marker used in our study, is produced in the human body mainly by the glycosylate pathway, and the normal serum value is in the Nano - to micro molar range; thus, the elevation of D - lactate is almost always pathological with strong association found in short bowel syndrome and intestinal ischemia/strangulation and gangrene.^(4,5,6) Another study had also reported finding in favor of serum lactate as predictor of ischemia and strangulation and followed by gangrene⁽²⁾. D - lactate, specifically, was studied in a prospective study in patients with acute abdominal emergency including mesenteric ischemia⁽³⁾. They concluded that serum D - lactate can help in diagnosing patients with acute mesenteric ischemia. Studies found that serum D -

lactate is consistently increased in intestinal ischemia, with sensitivity and specificity of 82 and 72% respectively (7).

Hospital based prospective studies was conducted on 50 patients with diagnosis of acute intestinal obstruction and explorative laparotomy done (8). Acute intestinal obstruction was diagnosed by history, clinical examination and imaging modalities. Study was to evaluate role of serum D – lactate as markers of bowel Strangulation. Moreover, reported mortality rates after acute intestinal obstruction have found association with delay in surgical management with progression to strangulation in many cases (9). In a study by Demir et al done for identifying factors predicting the need for surgery, elevated CRP and lactate was significantly associated with bowel gangrene and an underlying predictive value for the need of surgery (32). Another study by Lin et al for evaluation of risk factors for intestinal gangrene identified that elevated lactate along with serum CRP was associated with bowel gangrene (33). Most of the lactate found in human body is L - lactate. Van Noord studied 49 patients with chronic gastrointestinal ischemia and found that L - lactate elevation was significantly increased in ischemia as compared with the non - ischemia group (16). Study by Ramprasad dhoon et al mean D - lactate level was 5.2±0.62 mmol/L in group with simple bowel obstruction and mean D - lactate level was 2.87±1.04 mmol/L in group with obstruction with strangulation and gangrene (8). The mean D - lactate level differences in both groups were statistically significant. D - lactate test sensitivity was 80.00%, specificity was 90.00%, PPV was 84.30% and NPV was 87.10% to detected the obstruction with strangulation (7) Pal et al observed that serum values of CRP and D - lactate were significantly higher in patients with strangulated bowel obstruction as compared with simple bowel obstruction (5.4 vs 2.7 mmol/L respectively, p<0.05). Using a cutoff value of 4.5 mmol/L for D - lactate, the sensitivity, specificity, PPV, and NPV were 75.0, 69.4, 52.7, and 86.2% respectively.

Hospital based prospective study was conducted on 50 patients by Dug tarq Hassan et al in patients with acute intestinal obstruction and explorative laparotomy done,

showed significantly elevated levels of lactate in patients with strangulation and subsequent gangrene (9). Serum D - lactate levels were significantly raised in strangulated bowel obstruction as compared with simple bowel obstruction (11). Another study by Lin et al for evaluation of risk factors for intestinal gangrene identified that elevated serum CRP and lactate was associated with bowel gangrene (33).

Most of the lactate found in human body is L - lactate. Van Noord studied 49 patients with chronic gastro - intestinal ischemia and found that L - lactate elevation was significantly increased in ischemia as compared with the no ischemia group (16). Markogiannakis et al had also reported finding in favor of serum lactate as predictor of ischemia and strangulation (1). D - lactate, specifically, was studied by Murray et al in a prospective study in patients with acute abdominal emergency including mesenteric ischemia (2). They concluded that serum D - lactate can help in diagnosing patients with acute mesenteric ischemia. Poeze et al found that serum D - lactate is consistently increased in intestinal ischemia, with sensitivity and specificity of 82 and 72% respectively (34). Evennett et al have also added to this point of view (35).

Recently, a retrospective study (36) has shown that increase in I - FABP levels in patients with small bowel obstruction can be used to predict strangulation. The I - FABP can be increased with dynamic recycling of enterocytes during ischemia or strangulation, but I - FABP measurement requires a long period of time, while measurement of serum CRP and serum D - lactate can be done in a short span of time. Another study evaluating proc alcitonin as a marker for strangulation in cases of acute small bowel obstruction found it to have a PPV of 95% and an NPV of 90% and in multiple studies different kind of biochemical markers also taken into account to assess relation with intestinal obstruction (10, 12 - 15, 17 - 31). However, the results of this study should be taken into account along with the possibility of bacterial translocation occurring in cases of intestinal obstruction without strangulation resulting in false elevation of procalcitonin.

Table 1: Comparison of Different Studies

Study	D - Lactate					
	Simple BO (mmol/L)	I O with strangulation/ Gangrene (mmol/L)	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Ramprasad Dhoon et al	2.87	5.82	80	90	84.3	87
Dug Tariq et al	2.87	5.82	80	90	84.3	87
Ajay K Pal et al	2.7	5.4	75	69	52.2	86.2

4. Relevance

The main strength of our study lies in the fact that it is a prospective study with applicability in an emergency setting in a developing country, where availability of computed tomography (CT) and other costly biomarkers is beyond the reach of poor patients. Also, the patients in our study included those with both small and large bowel obstruction. However, there are certain limitations to the study as well. First of all, study participants were less in number and patients of pediatric age group were not part of this study. Second, the markers studied was only D - lactate, and there was no separation of patients requiring resection of bowel due to

strangulation. Another limitation in our study was the time required for analyzing D - lactate that ranged from 6 to 48 hours depending on availability of the D - lactate assay kit in our emergency setting, with each testing costing about 150 INR. Lastly, the radiological findings, postoperative outcome, length of hospital stay, and follow - up were not assessed by markers with regard to diagnosis of strangulation.

For tackling these limitations, a prospective study involving a large number of patients of pediatric, adolescent, and adult age groups for evaluating the role of various biomarkers including serum CRP, D - lactate, pro - calcitonin, and I - FABP is required in patients with acute intestinal obstruction, and correlation of these markers with radiological findings on

X - ray or contrast - enhanced CT abdomen should be sought. Such a study would help in decreasing the time interval to surgery in cases of acute intestinal obstruction with strangulation as well as decreasing unwarranted laparotomy in those cases of intestinal obstruction without strangulation, in which a trial of conservative management seems feasible based on other parameters and clinical findings. Improvements in measuring techniques of D - lactate should be sought to limit measurement time and finding quick results for clinical decision making. These biomarkers can be readily available in the emergency setting after due consideration given to their clinical relevance at the institutional level.

The present study demonstrated that the serum levels of and D - lactate was significantly higher in patients with acute intestinal obstruction with strangulated and subsequent gangrenous bowel and played a role in discrimination between two groups with NPV of D - lactate considerably higher. The reason of a lower PPV could be due to small sample size, and the occurrence of strangulation in the study may not be actually mimicking the prevalence in population.

Nevertheless, this study does add to the current literature regarding the need of decision - making policy for management of acute intestinal obstruction incorporating the role of biochemical markers for predicting ischemia/strangulation and gangrene at the time of presentation.

5. Methodology

Study Design:

Diagnostic test evaluation

Study Setting:

Department of General surgery in Government Medical College Thiruvananthapuram

Study Period:

One year after obtaining Ethical Committee Clearance.

Study Population:

Patients admitted with features of acute Intestinal obstruction in general surgery wards in Government Medical College, Thiruvananthapuram

Study Subject:

Inclusion criteria:

- All Patients (Age > 18 yrs) admitted with features of acute intestinal obstruction in general surgery wards of MCH, Thiruvananthapuram.

Exclusion criteria:

- Patients with comorbid medical illness and with findings other than obstruction or strangulation or gangrene.
- Patients who do not give consent.

Sample Size:

Sample size calculated using the formula,

$$N = \frac{4 \times p \times q}{d^2}$$

Where,

N= sample size

p= sensitivity of D lactate

d= absolute precision=10%

In this study,

P=75%

(Reference⁽⁷⁾: According to the study conducted by Pal AK, Ansari MM, Islam N at Jawaharlal Nehru Medical College Aligarh, Uttar Pradesh, India)

$$N = \frac{4 \times 75 \times (100 - 75)}{(10)^2}$$

=75

So, the No of diseased subject =75

Prevalence of intestinal obstruction based on study by Naveed anjum Qureshi et al titled spectrum of intestinal obstruction is 60 %.

Hence minimum sample size required =75x100= 60

Sample size =125.

Sampling Technique:

Consecutive cases meeting eligibility criteria will be included in the study till the sample size attained.

Study Variables:

Sociodemographic Variables:

Name, age, gender, BMI, Hypertension, diabetes, hypercholesterolemia, addictions (smoking, alcoholism) and clinical findings of duration of symptoms, diffuse pain, generalized distension of abdomen, vomiting, fever, obstipation, history of previous abdominal surgery, shock (systolic blood pressure <90 mm of Hg), tenderness, guarding or rigidity and exaggeration of bowel sounds were taken for study.

Table 2: Features of Intestinal Obstruction

Features of intestinal obstruction
1. diffuse abdominal pain
2. abdominal distension
3. vomiting
4. obstipation
5. fever
6. abdominal tenderness
7. guarding/rigidity
8. exaggerated bowel sounds
9. hypotension/shock
10. history of abdominal surgeries

Co Variables:

- Acute intestinal obstruction - patients with clinical features of diffuse abdominal pain, distension, vomiting, obstipation, fever, generalized tenderness, guarding or rigidity, exaggeration of bowel sounds, hypotension/shock and with history of abdominal surgery.
- Serum D - lactate value. (normal level - < 2 mmol/L, >2.2 mmol/L in acute intestinal obstruction, > 6.4 mmol/L in acute intestinal obstruction with bowel gangrene)

Data Collection Method:

After getting written informed consent from all patients under my inclusion criteria in surgical wards, preformed questionnaire will be given. Data will be collected with help of medical records and semi structured questionnaire. Blood sample collected from the patients after getting consent, maximum volume of 1.5ml is sufficient for assessing serum D - lactate.

Data Collection Tool:

- With help of semi structured questionnaire
- Medical records

Data Analysis

- Data will be entered in excel sheets and analyzed using appropriate statistical software.
- All quantitative variables will be expressed as mean and standard deviation and all qualitative variables will be expressed as proportion.
- Receiver operating characteristic (ROC) curve will be drawn and cutoff values for the serum D - lactate will be calculate.
- Sensitivity, specificity, positive predictive values (PPVs), and negative predictive values (NPVs) will be calculate.

Ethical Considerations

- Ethical committee clearance will be obtained before initiating the study.
- Informed written consent will be obtained from all participants.
- All data collected will be kept confidential.
- No extra expenditure will be incurred from the patient as part of the study.
- They will be given the opportunity to ask questions and clarify their doubts regarding participation and will have full freedom to exit the study at any time.

6. Results

The study sample consisted of 125 persons with features of intestinal obstruction and underwent laparotomy. Out of this <= 50 age group is more in frequency (29.6 %), following which is >70 age group (24.8%). youngest participant being 40 years and most aged being 80 years

Table 3: Age Distribution

Age	Frequency	Percent
≤ 50	37	29.6
51 – 60	30	24
61 – 70	27	21.6
>70	31	24.8
Total	125	100

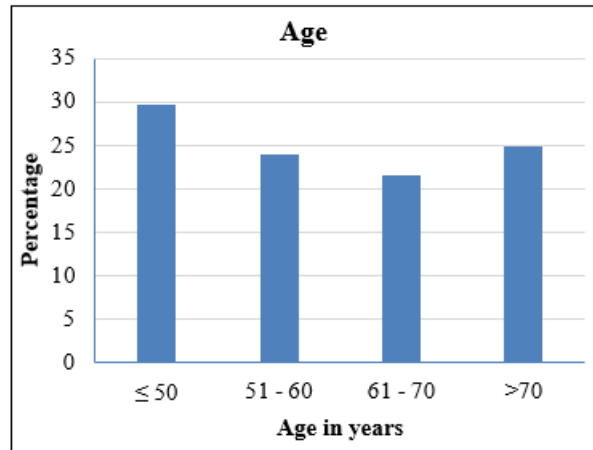


Figure 5: Age Distribution

Out of 125 stud subjects 38 are females (30.4%) and rest is male (69.6%)

Table 4: Sex Distribution

Sex	Frequency	Percent
Female	38	30.4
Male	87	69.6
Total	125	100

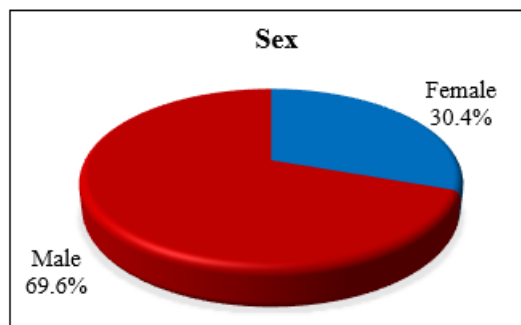


Figure 6: Sex Distribution

Patients presented with symptoms of intestinal obstruction of duration >24hrs is more frequently (68.8%) as compared to shorter duration (31.2%)

Table 5: Duration Distribution

Duration	Frequency	Percent
<24 hors	39	31.2
>24 hours	86	68.8
Total	125	100

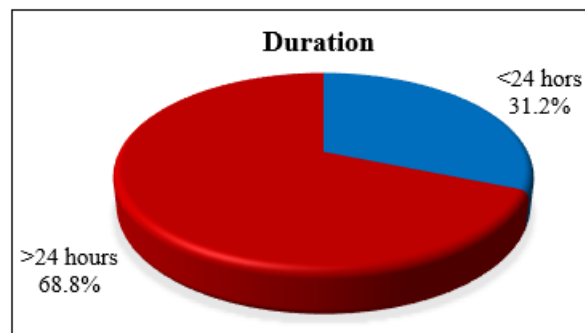


Figure 7: Duration Distribution

50.4% of the subjects have diffuse pain at the time of presentation.

Table 6: Diffuse Pain Distribution

Diffuse pain	Frequency	Percent
No	62	49.6
Yes	63	50.4
Total	125	100

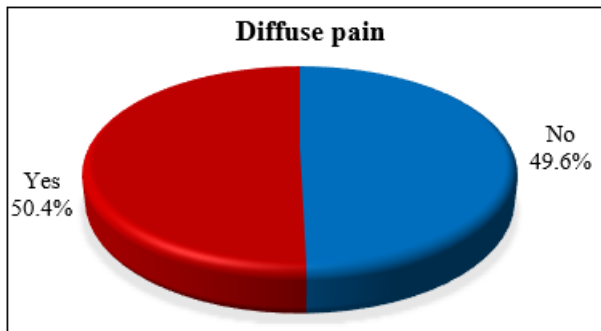


Figure 8: Diffuse Pain Distribution

In total subjects 52% have generalized distention at the time of presentation.

Table 7: Generalised Distension Distribution

Generalized Distension	Frequency	Percent
No	60	48
Yes	65	52
Total	125	100

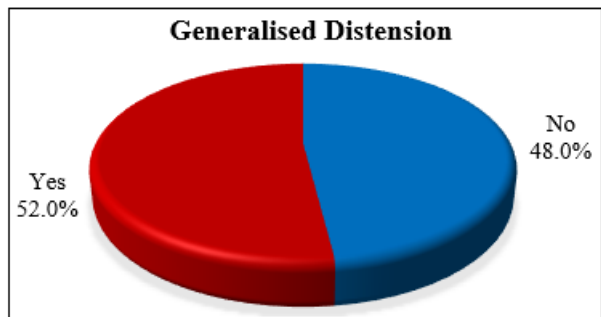


Figure 9: Generalised Distension Distribution

Vomiting was present in 60.8% of subjects with intestinal obstruction and rest of 39.2% had no complaints of vomiting.

Table 8: Vomitting Distribution

Vomiting	Frequency	Percent
No	49	39.2
Yes	76	60.8
Total	125	100

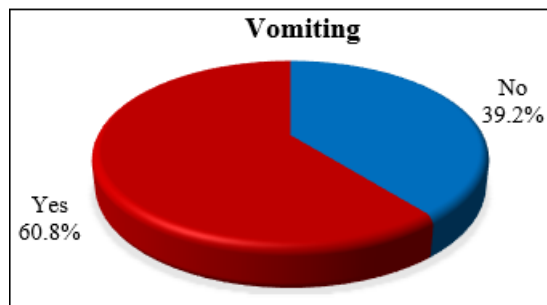


Figure 10: Vomitting Distribution

Majority of subjects (62.4%) won't have fever at the time of presentation.

Table 9: Fever Distribution

Fever	Frequency	Percent
No	78	62.4
Yes	47	37.6
Total	125	100

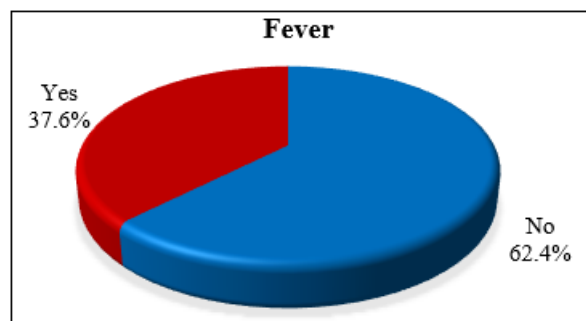


Figure 11: Fever Distribution

Obstipation was complaint for majority (66.4%) of subjects at the time of presentation.

Table 10: Obstipation Distribution

Obstipation	Frequency	Percent
No	42	33.6
Yes	83	66.4
Total	125	100

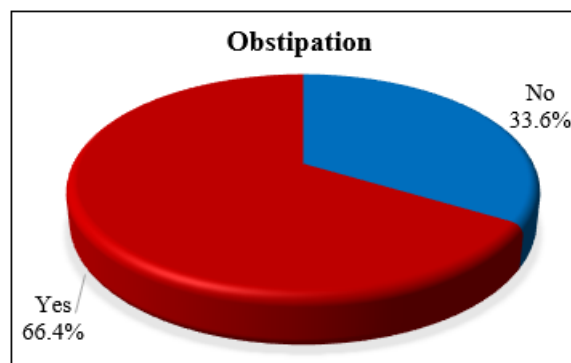


Figure 12: Obstipation Distribution

In total subjects with intestinal obstruction 31.2% had a history of previous abdominal surgery.

Table 11: History of Previous Abdominal Surgery Distribution

History of previous abdominal surgery	Frequency	Percent
No	86	68.8
Yes	39	31.2
Total	125	100

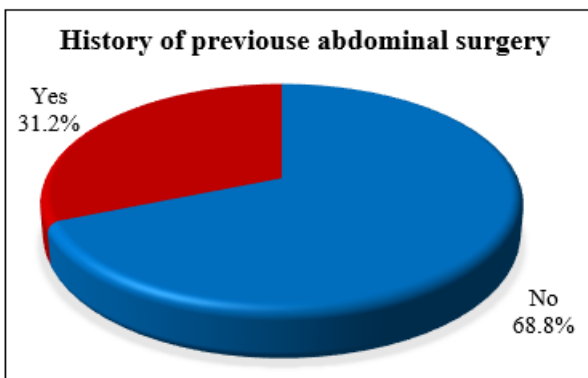


Figure 13: History of Previous Abdominal Surgery Distribution

In total subjects 30.4% subjects were in shock at the time of presentation.

Table 12: Shock Distribution

Shock	Frequency	Percent
No	87	69.6
Yes	38	30.4
Total	125	100

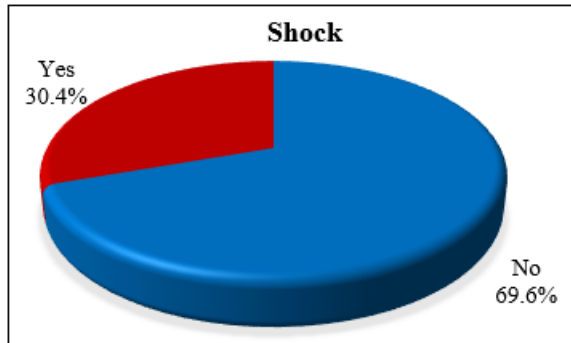


Figure 14: Shock Distribution

78.4% of subjects had abdominal tenderness in clinical examination.

Table 13: Tenderness Distribution

Tenderness	Frequency	Percent
No	27	21.6
Yes	98	78.4
Total	125	100

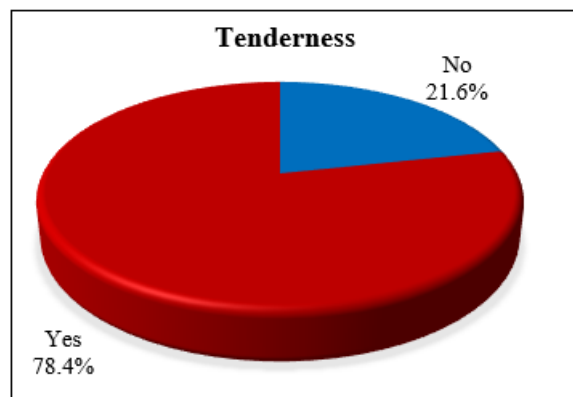


Figure 15: Tenderness Distribution

In clinical examination 50.4% of subjects had guarding /rigidity.

Table 14: Guarding/Rigidity Distribution

Guarding /Rigidity	Frequency	Percent
No	62	49.6
Yes	63	50.4
Total	125	100

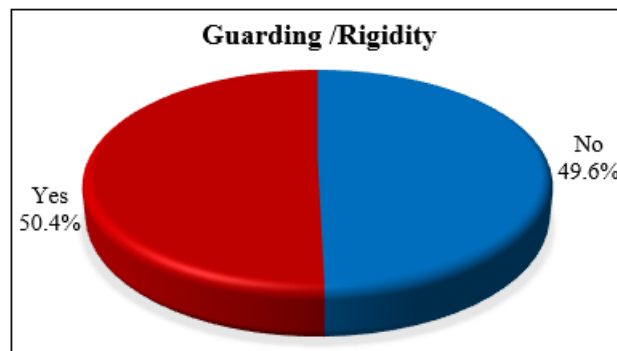


Figure 16: Guarding/Rigidity Distribution

36.8% of subjects had exaggerated bowel sounds. Which is mostly seen in early stages of simple bowel obstruction.

Table 15: Exaggeration of Bowel Sounds Distribution

Exaggeration of bowel sounds	Frequency	Percent
No	79	63.2
Yes	46	36.8
Total	125	100

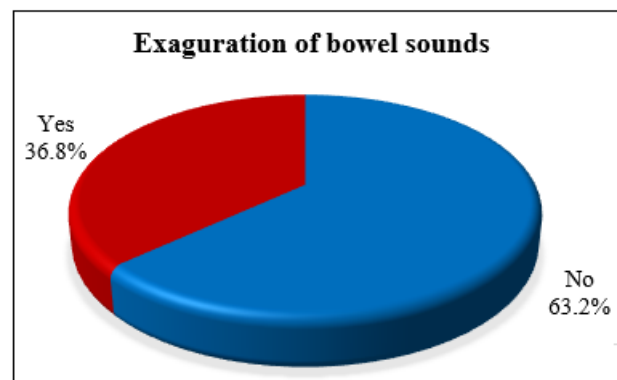


Figure 17: Exaggeration of Bowel Sounds Distribution

In total subjects who were presented with intestinal obstruction and underwent laparotomy, 28% of subjects found to have bowel gangrene / pregangrenous changes.

Table 16: Bowel Gangrene Distribution

Bowel gangrene	Frequency	Percent
No	90	72
Yes	35	28
Total	125	100

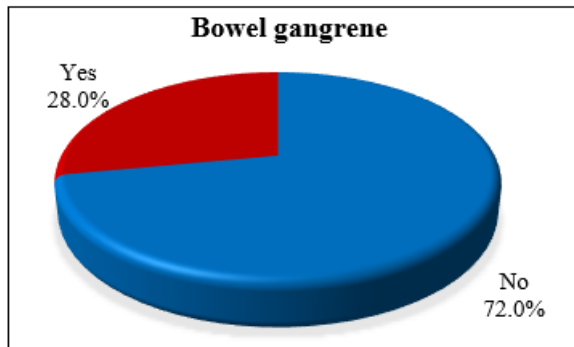


Figure 18: Bowel Gangrene Distribution

In my study no significant direct association with age and sex with bowel gangrene incidence. Even though in my study more frequency of incidence of bowel gangrene noticed in elderly patients (41.9%). another finding is that even though incidence of intestinal obstruction is less in females compared to males, but frequency of incidence of bowel gangrene is more (31.6%) in female patients.

Table 17: Age and Bowel Gangrene

Age	Bowel gangrene				Total		χ^2	df	p
	No		Yes		N	%			
	N	%	N	%					
≤50	29	78.4	8	21.6	37	100	4.721	3	0.193
51 – 60	24	80	6	20	30	100			
61 – 70	19	70.4	8	29.6	27	100			
71+	18	58.1	13	41.9	31	100			
Total	90	72	35	28	125	100			

Table 18: Sex and Bowel Gangrene

Sex	Bowel gangrene				Total		χ^2	df	p
	No		Yes		N	%			
	N	%	N	%					
Female	26	68.4	12	31.6	38	100	0.347	1	0.556
Male	64	73.6	23	26.4	87	100			
Total	90	72	35	28	125	100			

There is no direct association between bowel gangrene and duration of presentation. Even though incidence of bowel gangrene is more frequent in patients with duration of >24 hrs. (29.1%). There is significant association with bowel gangrene and patients present with diffuse pain (39.7%).

Table 19: Duration and Bowel Gangrene

Duration	Bowel gangrene				Total		χ^2	df	p
	No		Yes		N	%			
	N	%	N	%					
<24 hours	29	74.4	10	25.6	39	100	0.156	1	0.692
>24 hours	61	70.9	25	29.1	86	100			
Total	90	72	35	28	125	100			

Table 20: Diffuse Pain and Bowel Gangrene

Diffuse pain	Bowel gangrene				Total		χ^2	df	p
	No		Yes		N	%			
	N	%	N	%					
No	52	83.9	10	16.1	62	100	8.599	1	0.003
Yes	38	60.3	25	39.7	63	100			
Total	90	72	35	28	125	100			

There is significant association with bowel gangrene and generalized distention and vomiting (p value is <0.05). in case of patients with generalized distention of abdomen at the time of presentation, frequency of bowel gangrene incidence is more (44.6%). In my study most of the patients with bowel gangrene had complaints of vomiting.

Table 21: Generalised Distention and Bowel Gangrene

Generalized Distention	Bowel gangrene				Total		χ^2	df	p
	No		Yes		N	%			
	N	%	N	%					
No	54	90	6	10	60	100	18.5	1	<0.001
Yes	36	55.4	29	44.6	65	100			
Total	90	72	35	28	125	100			

Table 22: Vomiting and Bowel Gangrene

Vomiting	Bowel gangrene				Total		χ^2	df	p
	No		Yes		N	%			
	N	%	N	%					
No	45	91.8	4	8.2	49	100	15.7	1	<0.001
Yes	45	59.2	31	40.8	76	100			
Total	90	72	35	28	125	100			

In my study there is direct association between bowel gangrene and fever and obstipation.48.9% of patients with bowel gangrene had fever, obstipation also more in the subjects with bowel gangrene.

Table 23: Fever and Bowel Gangrene

Fever	Bowel gangrene				Total		χ^2	df	p
	No		Yes		N	%			
	N	%	N	%					
No	66	84.6	12	15.4	78	100	16.38	1	<0.001
Yes	24	51.1	23	48.9	47	100			
Total	90	72	35	28	125	100			

Table 24: Obstipation and Bowel Gangrene

Obstipation	Bowel gangrene				Total		χ^2	df	p
	No		Yes		N	%			
	N	%	N	%					
No	35	83.3	7	16.7	42	100	4.03	1	0.045
Yes	55	66.3	28	33.7	83	100			
Total	90	72	35	28	125	100			

The risk of incidence of intestinal obstruction is more in patients with history of abdominal surgery. But there is no direct association with bowel gangrene and history of previous abdominal surgery. There is direct association with bowel gangrene and shock, 84.2% of patients with bowel gangrene were in shock at the time of presentation.

Table 25: Previous Abdominal Surgery and Bowel Gangrene

History of previous abdominal surgery	Bowel gangrene				Total		χ^2	df	p
	No		Yes		N	%			
	N	%	N	%					
No	58	67.4	28	32.6	86	100	2.841	1	0.092
Yes	32	82.1	7	17.9	39	100			
Total	90	72	35	28	125	100			

Table 26: Shock and Bowel Gangrene

Shock	Bowel gangrene				Total		χ^2	df	p
	No		Yes		N	%			
	N	%	N	%					
No	84	96.6	3	3.4	87	100	85.57	1	<0.001
Yes	6	15.8	32	84.2	38	100			
Total	90	72	35	28	125	100			

There is no direct association with tenderness and bowel gangrene, even though most of the patients with bowel gangrene will have severe abdominal tenderness. Similarly guarding /rigidity also more common in patients with bowel gangrene, even though direct association is not there.

Table 27: Tenderness and Bowel Gangrene

Tenderness	Bowel gangrene				Total		χ^2	df	p
	No		Yes		N	%			
	N	%	N	%					
No	21	77.8	6	22.2	27	100	0.57	1	0.450
Yes	69	70.4	29	29.6	98	100			
Total	90	72	35	28	125	100			

Table 28: Guarding/Rigidity and Bowel Gangrene

Guarding /Rigidity	Bowel gangrene				Total		χ^2	df	p
	No		Yes		N	%			
	N	%	N	%					
No	49	79	13	21	62	100	3.018	1	0.082
Yes	41	65.1	22	34.9	63	100			
Total	90	72	35	28	125	100			

Exaggeration of bowel sounds is more with simple bowel obstruction (84.8%) than obstruction with bowel gangrene.

Table 29: Exaggeration of Bowel Sounds and Bowel Gangrene

Exaggeration of bowel sounds	Bowel gangrene				Total		χ^2	df	p
	No		Yes		N	%			
	N	%	N	%					
No	51	64.6	28	35.4	79	100	5.899	1	0.015
Yes	39	84.8	7	15.2	46	100			
Total	90	72	35	28	125	100			

Table 30: Chi - Square Tests

	N	Serum lactate (mmol/L)		p
		Mean	Sd	
Age	≤ 50	37	3.79	0.098
	51 - 60	30	3.96	
	61 - 70	27	4.49	
	>70	31	4.83	
Sex	Female	38	4.85	0.017
	Male	87	3.97	
Duration	<24 hors	39	3.94	0.236
	>24 hours	86	4.37	
Diffuse pain	No	62	3.91	0.051
	Yes	63	4.56	
Generalised Distension	No	60	3.63	<0.001
	Yes	65	4.80	
Vomiting	No	49	3.30	<0.001
	Yes	76	4.85	
Fever	No	78	3.89	0.006
	Yes	47	4.82	
Obstipation	No	42	3.60	0.006
	Yes	83	4.56	
History of previous abdominal surgery	No	86	4.37	0.232
	Yes	39	3.94	
Shock	No	87	3.61	<0.001
	Yes	38	5.68	
Tenderness	No	27	3.49	0.019
	Yes	98	4.45	
Guarding /Rigidity	No	62	4.07	0.307
	Yes	63	4.41	
Exaggeration of bowel sounds	No	79	4.50	0.040
	Yes	46	3.79	
Pre gangrenous change/Bowel gangrene	No	90	3.48	<0.001
	Yes	35	6.18	

ROC curve of Serum Lactate to predict Gangrene

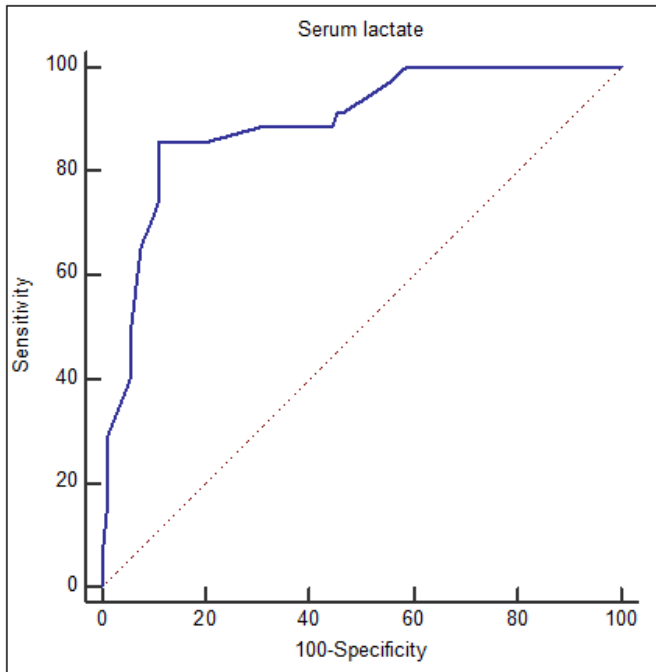


Figure 19: ROC Curve

Table 31: ROC Table

ROC curve		
Variable	Serum lactate (mmol/L)	
Classification variable	Gangrene	
Sample size		125
Positive group: Gangrene		35
Negative group: Non Gangrene		90
Area under the ROC curve (AUC)	0.891	
Standard Error	0.032	
95% Confidence interval	0.823 to 0.940	
Youden index J	0.746	
Associated criterion	>5	
Sensitivity	85.71	
Specificity	88.89	

Table 32: Summary of ROC Curve

S. Lactate	Sensitivity	Specificity	+PV	- PV
≥1.8	100	0	28	
>2.8	100	41.11	39.8	100
>2.9	97.14	44.44	40.5	97.6
>3	91.43	53.33	43.2	94.1
>3.4	91.43	54.44	43.8	94.2
>3.5	88.57	55.56	43.7	92.6
>3.9	88.57	68.89	52.5	93.9
>4	85.71	80	62.5	93.5
>5	85.71	88.89	75	94.1
>5.6	74.29	88.89	72.2	89.9
>5.7	71.43	90	73.5	89
>5.8	65.71	92.22	76.7	87.4
>5.9	48.57	94.44	77.3	82.5
>6	40	94.44	73.7	80.2
>7	28.57	98.89	90.9	78.1
>7.8	14.29	98.89	83.3	74.8
>8	5.71	100	100	73.2
>9	0	100		72

When cut off value kept at 5 mmol/L of serum lactate, the sensitivity will be 85.71% and specificity will be 88.89% with positive and negative predictive values of 75% and 94.1% respectively.

7. Discussion

In this study one hundred and twenty five patients with acute abdomen were suspected as having bowel obstruction who underwent laparotomy in the surgical wards of Govt. Medical College, Thiruvananthapuram. It was found that patients presented with symptoms of obstruction most of the duration is more than 24hrs and predisposition more in males comparing to females. Most common age group of less than 50yrs and next common in more than 70 yrs. Another clinical finding of diffuse pain and generalized distention was present in half of the subjects. Almost two third of the patients have symptoms of vomiting and obstipation, but only less than one third was having fever and features of shock. Previous history of abdominal surgery was seen in nearly one third of patients. More than two third of patients have tenderness and half of the subjects have rigidity/guarding. Around one third of the subjects presented with symptoms of obstruction have exaggerated bowel sounds. Blood samples of all of these patients were taken for measurement of desired biochemical markers. According to the findings of surgery, they were divided into two groups: Those with simple bowel obstruction or those with strangulated bowel obstruction with pregangrenous or gangrenous changes. On comparing the clinical findings, presence of exaggerated bowel sounds was significantly higher in simple obstruction ($p < 0.05$). Strangulation with pregangrenous or gangrenous changes was present in 35 out of 125 patients with small bowel obstruction. Among blood investigations, serum D - lactate were significantly higher in patients with strangulated bowel obstruction with gangrene as compared with simple bowel obstruction (6.18 vs.3.48 mmol/L respectively, $p < 0.05$). Using ROC analysis the area under the curve of serum D - lactate was found to be 0.891 for strangulation with pregangrenous or gangrenous bowel. For predicting strangulation with bowel gangrene, using a cutoff value of 5 mmol/L for D - lactate, the sensitivity, specificity, PPV, and NPV were 85.71%, 88.89%, 75% and 94.1% respectively. The present study demonstrated that the serum levels of and D - lactate was significantly higher in patients with acute intestinal obstruction with strangulation and subsequent bowel gangrene than patients with simple bowel obstruction and played a role in discrimination between two groups.

8. Conclusion

Intestinal obstruction is one of the commonest clinical problems encountered in surgical practice. One of the grave complications of intestinal obstruction is strangulation and subsequent gangrene, which requires an emergency laparotomy for management. The present study demonstrated that the serum levels of D - lactate was significantly higher in patients with acute intestinal obstruction with strangulation and subsequent bowel gangrene than patients with simple bowel obstruction and played a role in discrimination between two groups. From the results of this study there is statistically significant relation between the serum lactate value and bowel gangrene. So serum D - lactate can be useful and reasonable markers for predicting strangulation and bowel gangrene in cases of acute intestinal obstruction in an emergency setting.

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Annexure 1

Informed Consent

This informed consent is for patients under General Surgery with acute intestinal obstruction in Government Medical College, Thiruvananthapuram, and are willing to participate in my clinical study. **“D - LACTATE AS PREDICTIVE TOOL FOR ASSESSING BOWEL GANGRENE IN PATIENTS ADMITTED WITH ACUTE INTESTINAL OBSTRUCTION IN SURGICAL WARDS OF GOVERNMENT MEDICAL COLLEGE THIRUVANANTHAPURAM”.**

Dr. Sameena Chaloli
Junior Resident
Department of General Surgery
Government Medical College
Thiruvananthapuram
Phone No: 9497464082
Email id: sameenanasru[at]gmail.com

This Informed Consent has two parts:

1. Information Sheet (to share information about the research with you)
2. Certificate of Consent (for signatures if you agree to take part)

You will be given a copy of the full Informed Consent Form.

Annexure 2

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Annexure 3

Part I: Information Sheet

I, Dr. SAMEENA CHALOLI, am a junior resident in the Department of General Surgery. I am doing a clinical study on D - lactate as predictive tool for assessing bowel gangrene in patients admitted with acute intestinal obstruction in surgical wards of Government Medical College Thiruvananthapuram. The relevant information regarding the study would be provided to you, and after due consideration, you can decide whether to participate in this study or not. Prior to it, you are free to discuss about the research with anyone you feel comfortable with. In case of any doubts or clarifications while we go through the information, please ask me to stop, and I would explain them to you.

Acute Intestinal obstruction is one of the commonest clinical problems encountered in surgical practice. One of the grave complications of intestinal obstruction is strangulation and gangrene, which requires an emergency laparotomy for management. Ischemia, which complicates bowel obstructions, significantly increases mortality associated with bowel obstruction. Time is an essence, with an earlier diagnosis of strangulation favoring increased patient's survival, which is primarily clinical, with a sudden onset of pain, i. e., continuous rather than colicky, the early appearance of shock, and the presence of fever, tachycardia, marked abdominal tenderness, guarding, rebound tenderness, and a tender abdominal mass are all in favor of the diagnosis of strangulation and which may further lead to gangrene. Lactic acid is the normal endpoint of the anaerobic breakdown of glucose in the tissues. D - lactate is detected in a situation of an abnormal proliferation of enteral bacterial flora due to mucosal injury following mesenteric ischemia. Hence, I am doing this research for early detection of bowel gangrene in patients with acute intestinal obstruction, using serum levels of D - lactate by collecting 1.5 ml of blood from patients, for early intervention and active management in order to reduce morbidity and mortality among patients with acute intestinal obstruction.

I am inviting all patients of either gender admitted with acute intestinal obstruction under General Surgery in Govt. Medical College, Thiruvananthapuram, to participate in this research. I will be examining you and coping relevant history, physical parameters like BMI, relevant laboratory investigations and imaging studies from the patient case sheet.

Your participation in this research is entirely voluntary and you will not have any financial burden incurred as part of this study. Whether you choose to participate or not, all the services you receive at this hospital will continue and nothing will change. If you choose not to participate in this research project, you will be offered the standard treatment that is routinely offered in this hospital. You may stop participating in the research at any time that you wish without losing any of your rights as a patient here. Your treatment at this clinic will not be affected in any way.

The information that I collect from this research project will be kept confidential. The results of the study may be published in order that other interested people may learn from this research.

If you have any questions you may ask them now or later, even after the study has started. If you wish to ask questions later, you may contact

Dr. Sameena Chaloli
Phone no: 9497464082
Email id: [sameenanasru\[at\]gmail.com](mailto:sameenanasru@gmail.com)

This proposal has been reviewed and approved by the Institutional Research Committee, Government Medical College, Thiruvananthapuram, constituted under State Board of Medical Research, which is a committee whose task is to make sure that research participants are protected from harm. It has also been reviewed by the Human Ethics Committee of Government Medical College, Thiruvananthapuram.

Part II: Certificate Of Consent

I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions that I have asked have been answered to my satisfaction. I consent voluntarily to participate in this research.

Name of Participant

Signature of Participant

Date

If Illiterate

I have witnessed the accurate reading of the consent from to the potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

Name of witness and Thumb print of participant

Signature of witness

Date

Statement by the researcher /person taking consent

I have accurately read out the information sheet to the potential participant, and to the best of my ability made sure that the participant understands that the following will be done:

- 1) I will be noting down the patients details, socio - demographic details, investigation results, details of comorbidities, concurrently administered medications and any treatment details.
2) The patient would be asked for a brief history and examined at the time of admission.
3) Routine and case specific investigations will have to be done by the patient.

I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

A copy of this Informed Consent Form has been provided to the participant.

Name of Researcher

Signature of Researcher

Date

Annexure 4

H[mw`mKw p tcmKn Adn - a n - cn - t;- Imcy - \$A

Rm3 tUm. kao\ Nmtem - fn, Xncp - h - \ - ' -]pcw saUn - jA tImtf - PnA P\ - dA kAOdn hn`m - K - nA]n. - Pn. hnZymA`on\n BWv. IpSA XS - E - hp - ambn P\ - dA kAOdn hn`m - K - nA hcp\ tcmKn - I - fnA_hA KmW{Ko3 D-m - Ip - [pt-m F\ - dn - bm3 ca - nse Unp emIvtA - aansA Afhv F\$S\ {]h - N\ D]m - [n - bmbn FSp;mw F\ - Xns\]an - bmWv]Tn - jm3 Dt± - in - jp - \ - Xv. AXn - \mbn Rm3 Cu]T - \ - n - tebv;v Xm!sf £Wn - jp - \p. Xm!A Cu]T - \ - nA]s! - Sp - jtWm F\ v C\p - Xs\ Xocp - am - \n - tj - - - Xn - A. CXnA]s! - Sp - jp - \ - Xn\p ap1/4mbn Xm!A;ip XmA] - cy - apA GXv hyan - bp - ambpw CXn - s\ - jp - dn`v NA` sNcm - hp - \ - Xm - Wv.

Xmsg]d - bp - \ - h - bnA Xm!A;iv a - \ - En - em - Im`]Z - \$A D-m - Imw. hnh - c - \$A hmbn - jp - \ - Xn\nSbnA Ft,mA thW - sa - \nepw Ft\mSv \nA`p - hm3 Bh - iy - s, - Smw. Rm3 Xm!A;iv hni - Zo - I - cn`v Xcp - \ - Xm - bn - cn - jpw. AXn - \p - tijw Xm!A;iv kwibw _m;in - bp - s - \nA Ft\mSv tNmZn - jm - hp - \ - Xm - Wv.

s]s\ hcp\ IpSA XS Ew hfsc A [n - I - ambn I-p - h - cp\ Hcp Akp - J - am - Wv. CXnsa hnb `hn - jy`v Fs` - \mA IpS - en - tem - pA ca - tbm«w Ipd - bp - Ibpw_hA KmW{Ko3 Bbn amdp - Ibpw sNcm3 km [yX D-v F\ - Xm - Wv. C\$S\ DAh s]s\ Hm, - td - j3 sNt; - - - Xp - am - Wv. kabw hfsc Aaq - ey - am - Wv. km [m - cW cn\n - jnA]cn - tim - [- \ - IA hgn - bmWv IpS - en - tem - pA ca - tbm«w Ipd - bp - [pt-m F\ v a\ - En - em - jp - \ - Xv. AXn ian - bmb hbdp thZ - \,]n, lrZ - b - an - Sn_v {Iam - Xo - X - ambn hA2n;ip - I, hbA hoA;ipI F\ n - h - sbAmw CXnsa e£ - W - \$ - fm - Imw. Unp - em - IvtAav ico - c - nA ca - tbm«w Ipd - bp - \ - Xnsa ^e - ambn HmIvkn - P3 Ipd - bp - t1/4mA D-m - Ip\ cmk {}{In - b - IA hgn D-m - Ip - \ - Xm - Wv. AXn - \mA, IpS - enA ca - tbm«w Ipd - bp - t1/4mA CXnsa Afhv {Iam - Xo - X - ambn ico - c - nA hA2n - jm3 km [y - X - bp - -v. tcmKn - bpsS ico - c - nA \n\pw shdpw 1.5 anAo enA ca]cn - tim - [n`v ca - n - epA Unp - em - IvtA - aansA Afhv IW - jm - jm - hp - \ - XmWv AXp - hgn C\$ - s\ - bpA tcmKn - I - fnA t]c - t` - bpA IrXy - amb NnInO acW km [yX Ipd - bv;im3 klm - bn - jp - \ - Xm - Wv.

IpSA XS - E - hp - ambn Xncp - h - \ - ' -]pcw Kh`saav saUn - jA tImtf - PnA P\ - dA kAOdn hn`m - K - n\p IognA hcp\ FA m tcmKn - I - sfbpw Cu]T - \ - n - te;v £Wn - jp - \p. Rm3 \n\$sf]cn - tim - [n - jp - I - bpw, \n\$ - fpsS AkpJ hnh - c - \$A, et_m - d - «dn]cn - tim - [m ^e - \$A, imco - cnI Af - hp - IA, kvIm3 dnkA«p - Ifpw \n\$ - fpsS NnInOm tcJ - bnA \n\ v tij - cn - jp - \ - Xm - bn - cn - jpw.

Xm! - fpsS Cu]T - \ - nse]m - fn`w kzta - [bm Xncp - am - \n - jm - hp - \ - Xm - Wv. Xm!A Cu]T - \ - nA]s! - Sp - jm3 k1/2 - Xn - ` - Xn\p tijhpw Ft,mA thW - sa - \nepw Xm!A;iv CXnA \n\pw]n - m - dmw. AXv \n\$ - fpsS NnIn - O - tbtbm e`n - jp\ B\p - Ip - ey - \$ - tftbm bmsXmcp hn [- n`nepw _m [n - jp - I - bn - A. Cu]T]w tcmKn;iv Hcp tZmjhpw D-m - jnA F\ v Dd,p Xcp - \p. Kth - j - W - hp - ambn _O - s,«v Xm!A;iv Hcp km1/4 - nI _m [y - Xbpw D-m]p - \ - X - A. Xm! - fnA \n\ v tij - cn -

jp¶ hnh - c - §Ä cl - ky - ambn kqfn - jp - ¶ - Xm - Wv. Cu]T - \ - nsâ ^ew, Kth - j - W - nÂ XmÂ] - cy - ap - Å - h - cpsS]W - n - \mbn Nne - t,mÄ {jkn - 2o - I - cn - jp - ¶ - Xm - bn - cn - ipw.

\n§Ä;v Fs' - lnepw tNmZy - §Ä Bcm - bp - ¶ps- - lnÂ Ct,m - tgm, AsÄ - lnÂ]n¶o - tSm, AXp - a - sÄ - lnÂ]T\w XpS - §n - b - Xn\p tijtam tNmZn - im - hp - ¶ - Xm - Wv. AXn - \mbn Fs¶ _Ô - s, - Sm - \pÄ \¼Ä tijw sImSp - jp - ¶p.

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Cu]T\ - s- - jp - dn - pÄ \nÂt± - iw, tÄv t_mÀUv Hm^v saUn - jÄ dnkÀ'n - \p - Io - gnÂ, Xncp - h - \ - ' -]pcw Kh=saâv saUn - jÄ tImtf - Pn - epÄ Øm] \ Kth - jW kanXn (IRC) hne - bn - cp - p - Ibpw AwKo - Imcw \ÄIp - Ibpw sNbvX - XmWv. AXp - t]mse Xncp - \ - ' -]pcw Kh: saUn - jÄ tImtf - Pnse lyqa- F nIvkv I½n - änbpw hne - bn - cp - n - b - Xm - Wv.

c-mw`mKw p k½ - X -]{Xw

taÄ, - dª hnh - c - § - sfÄmw Rm³ hmbn`p a\ - Ên - em;n AYhm Fs¶ hmbn`p tLÄ,n - `p. F\;v kwibw tNmZn - im - \pÄ Ah - kcw \ÄIp - Ibpw tNmZy - §Ä;v Xr]vXn - I - c - amb D- - c - §Ä \ÄIp - Ibpw sNbvXp. Rm³ kzta - [bm Cu]T - \ - nÄ]s! - Sp - jp - hm³ k½ - Xn - jp - ¶p.

]s! - Sp - jp¶ hyàn - bpsS t]cv p

]s! - Sp - jp¶ hyàn - bpsS H,v p

XobXn p

\nc - £ - c - cmb hyàn - bm - sW - lnÂ

]T - \ - s- - jp - dn - pÄ hnh - c - §Ä]T - \ - nÄ]s! - Sp - jp¶ Cu hyànbv;v IrXy - ambn hmbn`ptLÄ,n`Xn\p Rm³ kmfn - bm - Wv. Ct± - l - n\ v tNmZy - §Ä tNmZn - im - \p - ff Ah - kcw \ÄIn - bn - cn - jp - ¶p. Ct±lw kzta - [- bm - bmWv Cu]T - \ - nÄ]s! - Sp - jm³ k½Xw \ÄIn - b - Xv.

kmfn - bpsS t]cv]s! - Sp - jp¶ hyàn - bpsS

kmfn - bpsS H,v hnc - e - S - bmfw

XobXn

\nco - £ - I - bpsS {]kvXm - h

tcmKn Adn - tb - - - Xm - bpÄ hnh - c - §Ä Rm³ tcmKnsb hmbn`p tLÄ,n - `n - «p - -v. Xmsg]d - bp¶ Imcy - §Ä BWv Rm³ sNc³m³ t]mIp - ¶ - Xv. F¶v tcmKnsb]dªp a\ - Ên - em - jm³ Rm³ {ian`n«p-v.

1. Rm³ tcmKn - bpsS t]kv sd;imÀUnÄ DÄ kzImcy hnh - c - §Ä NnInÖm hnh - c - §Ä, Ign - jp¶ acp - ¶p - I - fpsS hnh - c - §Ä, aâp tcmK - § - fpsS hnh - c - §Ä F¶nh tcJ - s, - Sp - p - ¶ - Xm - Wv.
2. tcmKnsb]Xnhv]cn - tim - [- \ - IÄ;v hnt [- b - am - jp - sa - ¶pw, tcmKn - bpsS NnIn - Öbv;v Bh - iy - amb cà -] - cn - tim - [- \ - IÄ \S - p - sa¶pw tcmKnsb]dªp a\ - Ên - em - jn.

tcmKn;v tNmZy - §Ä tNmZn - im - \pÄ Ah - kcw sImSp - n - cp - ¶p. tcmKn tNmZn` tNmZy - §Ä;v Xr]vXn - I - c - amb D- cw F¶mÄ BIp¶ hn [w \ÄIn - bn - «p - -v. bmsXmcp hn [- nepw \nÄ_ - Ôn - `n - «Ä tcmKnsb Cu]T\ nÄ DÄs, - Sp- n k½Xw hm§n - b - sX¶v Rm³ Dd,p Xcp - ¶p. Cu]T - \ - nse]im - fn- w tcmKn kzta - [bm Xocp - am - \n - - - Xm - Wv.]s! - Sp - jp¶ hyàn;v Cu A. - dn - thm - sS - bpÄ k½X]{X - nsâ Hcp]IÄ,v \ÄIp - ¶ - Xm - Wv.

tUm. kao\ Nmtemfn

H,v

XobXn

**Annexure 5
PROFORMA**

Sample No:

- 1) Name -
- 2) Age -
- 3) Sex -
- 4) IP No -
- 5) BMI -

- 6) Ward -
- 7) Address -
- 8) Date of Admission -
- 9) Date of surgery -
- 10) Date of Discharge -

- 11) Duration of Symptoms (Median, hours)
<24 hrs >24 hrs

- 12) Diffuse Pain
Yes No

- 13) Generalized distension
Yes No

- 14) Vomiting
Yes No

- 15) Fever
Yes No

- 16) Obstipation
Yes No

- 17) History of previous abdominal surgery
Yes No

- 18) Shock
Yes No

- 19) Tenderness
Yes No

- 20) Guarding/rigidity
Yes No

- 21) Exaggeration of bowel sounds
Yes No

- 22) Serum Lactate (mmol/L)
Yes No

Annexure 6

Key to Master Chart

Age		Sex		Duration		Diffuse pain		Generalised Distension	
<40	>40	Male	Female	<24 Hrs	>24 Hrs	Yes	No	Yes	No
0	1	1	0	0	1	1	0	1	0

Vomiting		Fever		Obstipation		History of previous abdominal surgery		shock	
Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
1	0	1	0	1	0	1	0	1	0

Tenderness		Guarding /Rigidity		Exaguration of bowel sounds		Serum lactate		Pre gangrenous change/Bowel ganrene	
Yes	No	Yes	No	Yes	No	(mmol/L)		Yes	No
1	0	1	0	1	0			1	0

Annexure 7

Master Chart

SL No	Age	Sex	Duration	Diffuse pain	Generalised Distension	Vomiting	Fever	Obstipation	History of previous abdominal surgery	shock	Tenderness	Guarding /Rigidity	Exaguration of bowel sounds	Serum lactate (mmol/L)	Pre gangrenous change/ Bowel ganrene
1	53	1	0	1	0	0	0	0	0	0	1	0	0	2.3	0
2	60	1	1	1	1	1	0	1	0	1	1	1	0	5.8	1
3	70	1	1	0	1	1	0	1	1	0	1	0	0	5.8	0
4	44	0	0	1	0	1	0	0	1	0	1	1	1	2.8	0
5	50	1	1	0	0	0	0	1	0	0	1	1	1	3.9	0
6	68	0	1	1	0	1	1	1	0	1	0	1	0	6	1
7	72	0	1	0	1	1	0	1	1	1	0	0	0	5.6	1
8	50	1	0	0	0	1	0	1	0	0	1	0	1	3	0
9	78	1	0	0	1	1	1	0	0	1	0	1	0	3.5	1
10	45	1	0	0	0	0	0	0	1	0	1	0	1	2.1	0
11	40	1	0	0	0	1	1	0	0	0	1	0	1	2	0
12	68	1	1	1	0	0	0	1	0	0	1	1	0	1.8	0
13	49	1	0	0	0	1	1	0	0	0	1	0	1	4.9	0
14	59	1	1	1	0	0	0	1	0	0	0	0	0	2.3	0
15	65	1	1	1	1	1	1	1	0	1	1	1	0	5.9	1
16	67	0	1	0	0	1	1	1	0	0	1	0	0	5	0
17	52	1	0	1	0	0	0	0	1	0	0	0	0	1.9	0
18	71	1	1	0	1	1	0	0	0	0	0	0	0	2	0
19	54	0	0	1	1	1	1	0	0	1	1	1	0	6	1
20	50	1	1	0	1	1	0	1	1	0	1	0	0	3.9	0
21	72	1	1	1	1	0	0	1	0	0	1	1	0	4	0
22	59	0	0	0	0	1	0	0	1	0	1	1	1	3.4	0
23	45	1	1	1	0	1	1	1	0	1	1	1	1	5.4	1
24	80	1	1	0	1	0	0	1	0	0	1	0	0	7	0
25	54	0	1	1	0	1	0	1	0	0	1	0	1	3.9	0
26	70	1	1	1	1	1	0	1	0	0	1	1	0	4	0
27	50	0	1	0	0	0	0	1	1	0	1	1	1	2.2	0
28	45	1	0	1	0	1	1	1	1	0	1	0	0	4	0
29	74	1	1	1	1	1	1	1	0	1	1	1	0	7.8	1
30	57	1	1	0	0	0	1	0	0	1	1	1	0	2.3	0
31	58	0	0	0	0	1	0	0	0	0	1	1	0	7	0
32	80	1	1	1	1	0	1	1	0	1	1	0	0	5.9	1
33	45	1	0	1	0	1	0	0	1	0	0	1	1	2.1	0
34	78	1	1	0	1	0	0	1	0	0	1	1	0	3.8	0

35	54	1	1	1	1	0	0	0	0	0	1	1	0	4.2	0
36	79	1	1	0	1	0	0	0	0	0	1	1	1	3.8	0
37	47	0	1	0	0	1	0	1	0	0	1	1	1	3.5	0
38	70	0	1	1	1	1	1	1	0	1	1	0	0	8	1
39	58	1	1	0	0	1	1	1	1	0	1	1	1	2.5	0
40	48	0	1	1	0	1	0	1	1	0	1	0	1	4	0
41	80	0	0	1	1	1	0	1	0	1	1	0	0	7.2	1
42	50	1	1	1	0	0	0	1	0	0	1	1	1	3	0
43	70	1	1	0	1	0	0	1	0	1	0	0	0	2.3	0
44	53	0	1	0	1	1	1	1	1	0	1	1	1	3.7	0
45	79	1	1	0	1	0	0	1	0	0	0	0	1	2.4	0
46	49	1	0	0	1	1	0	1	1	1	1	0	1	3	1
47	59	1	1	1	1	0	0	0	1	0	1	1	0	2.7	0
48	49	1	1	0	1	1	1	1	0	0	0	0	0	3	0
49	70	0	1	1	0	1	1	1	1	0	1	1	0	4.8	0
50	45	1	1	0	1	1	1	0	0	1	1	1	0	7	1
51	53	1	0	1	0	0	0	0	0	0	1	0	0	5.9	0
52	60	1	1	1	1	1	0	1	0	1	1	1	0	5.8	1
53	70	1	1	0	1	1	0	1	1	0	1	0	0	5.7	0
54	44	0	0	1	0	1	0	0	1	0	1	1	1	2.8	0
55	50	1	1	0	0	0	0	1	0	0	1	1	1	3.9	0
56	68	0	1	1	0	1	1	1	0	1	0	1	0	6	1
57	72	0	1	0	1	1	0	1	1	1	0	0	0	5.6	1
58	50	1	0	0	0	1	0	1	0	0	1	0	1	5.9	0
59	78	1	0	0	1	1	1	0	0	1	0	1	0	7.3	1
60	45	1	0	0	0	0	0	0	1	0	1	0	1	2.1	0
61	40	1	0	0	0	1	1	0	0	0	1	0	1	2	0
62	68	1	1	1	0	0	0	1	0	0	1	1	0	1.8	0
63	49	1	0	0	0	1	1	0	0	0	1	0	1	2.5	0
64	59	1	1	1	0	0	0	1	0	0	0	0	0	2.3	0
65	65	1	1	1	1	1	1	1	0	1	1	1	0	5.9	1
66	67	0	1	0	0	1	1	1	0	0	1	0	0	2	0
67	52	1	0	1	0	0	0	0	1	0	0	0	0	1.9	0
68	71	1	1	0	1	1	0	0	0	0	0	0	0	2	0
69	54	0	0	1	1	1	1	0	0	1	1	1	0	4	1
70	50	1	1	0	1	1	0	1	1	0	1	0	0	3.9	0
71	72	1	1	1	1	0	0	1	0	0	1	1	0	4	0
72	59	0	0	0	0	1	0	0	1	0	1	1	1	7	0
73	45	1	1	1	0	1	1	1	0	1	1	1	1	5.4	1
74	80	1	1	0	1	0	0	1	0	0	1	0	0	2.5	0
75	54	0	1	1	0	1	0	1	0	0	1	0	1	3.9	0
76	70	1	1	1	1	1	0	1	0	0	1	1	0	4	0
77	50	0	1	0	0	0	0	1	1	0	1	1	1	2.2	0
78	45	1	0	1	0	1	1	1	1	0	1	0	0	4	0
79	74	1	1	1	1	1	1	1	0	1	1	1	0	7.8	1
80	57	1	1	0	0	0	1	0	0	1	1	1	0	2.3	0
81	58	0	0	0	0	1	0	0	0	0	1	1	0	2.4	0
82	80	1	1	1	1	0	1	1	0	1	1	0	0	5.9	1
83	45	1	0	1	0	1	0	0	1	0	0	1	1	2.1	0
84	78	1	1	0	1	0	0	1	0	0	1	1	0	3.8	0
85	54	1	1	1	1	0	0	0	0	0	1	1	0	4.2	0
86	79	1	1	0	1	0	0	0	0	0	1	1	1	3.8	0
87	47	0	1	0	0	1	0	1	0	0	1	1	1	7	0
88	70	0	1	1	1	1	1	1	0	1	1	0	0	8	1
89	58	1	1	0	0	1	1	1	1	0	1	1	1	2.5	0
90	48	0	1	1	0	1	0	1	1	0	1	0	1	4	0
91	80	0	0	1	1	1	0	1	0	1	1	0	0	7.2	1
92	50	1	1	1	0	0	0	1	0	0	1	1	1	3	0
93	70	1	1	0	1	0	0	1	0	1	0	0	0	2.3	0
94	53	0	1	0	1	1	1	1	1	0	1	1	1	3.7	0
95	79	1	1	0	1	0	0	1	0	0	0	0	1	2.4	0
96	49	1	0	0	1	1	0	1	1	1	1	0	1	5.9	1
97	59	1	1	1	1	0	0	0	1	0	1	1	0	2.7	0
98	49	1	1	0	1	1	1	1	0	0	0	0	0	3	0
99	70	0	1	1	0	1	1	1	1	0	1	1	0	4.8	0
100	45	1	1	0	1	1	1	0	0	1	1	1	0	2.9	1
101	65	0	1	0	1	1	1	1	0	0	1	0	0	2.8	0

102	76	0	1	1	0	1	0	1	1	1	1	1	0	9	1
103	65	1	0	1	1	0	0	1	0	0	1	0	1	7	1
104	60	1	1	0	1	1	1	0	0	0	1	0	1	5.8	0
105	80	0	1	0	1	1	0	1	1	0	0	0	1	8	0
106	75	1	0	0	0	0	1	1	0	0	1	0	0	2.9	0
107	55	1	1	1	1	1	1	0	0	1	1	0	0	8	1
108	49	1	1	1	0	1	0	1	0	0	1	1	1	5.9	1
109	50	0	0	1	1	0	1	0	0	0	1	1	0	2.9	0
110	63	1	0	0	0	0	0	1	0	0	0	0	0	3	0
111	59	0	1	1	0	0	0	1	1	0	1	0	1	2.7	0
112	63	0	0	1	1	1	1	1	0	1	1	1	0	7	1
113	46	1	1	0	1	1	1	1	1	1	1	1	0	9	1
114	58	1	1	0	1	1	1	1	0	0	1	0	1	5.7	1
115	67	1	1	1	1	0	0	0	0	0	1	1	0	3	0
116	76	1	1	1	0	0	0	0	1	0	1	0	0	4	0
117	63	1	0	1	0	0	0	1	0	0	0	0	0	4.8	0
118	80	1	0	1	1	1	0	0	0	0	0	0	0	2.5	0
119	73	1	1	1	1	1	1	1	0	1	1	1	0	7	1
120	64	1	0	1	0	0	0	1	1	0	1	0	1	2.5	0
121	78	1	1	1	1	0	0	1	1	1	1	1	0	3	1
122	73	1	0	0	1	0	1	1	0	0	0	0	1	2.9	0
123	70	0	1	0	0	0	0	0	0	0	0	0	0	3	0
124	66	1	1	0	0	1	0	0	0	1	0	0	0	4	0
125	80	0	1	1	1	0	1	1	0	1	1	1	0	5	0

Annexure 8

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