Original Research Article

A prospective study of serum C-reactive protein and D-lactate levels for early prediction of strangulation in intestinal obstruction

Ramprasad Dhoon, Suresh Kumawat*, M. L. Soni, M. K. Rohella,
Sunil Sharma, Vinod Karosia, Rajesh Chahil

Department of Surgery, J. L. N. Medical College and Hospital, Ajmer, Rajasthan, India

Received: 18 April 2019

Accepted: 12 June 2019

*Correspondence:

Dr. Suresh Kumawat,

E-mail: sureshkumawat@gmail.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: Intestinal obstruction is one of the commonest clinical problems encountered in surgical practice. One of the grave complications of intestinal obstruction is strangulation, which requires an emergency laparotomy for management. This study was conducted to emphasise the significance of early estimation of rise in serum C-reactive protein and D- lactate levels.

Methods: Hospital based prospective study was performed on 50 patients admitted in J.L.N. Hospital, Ajmer in various surgical units with diagnosis of acute intestinal obstruction and underwent explorative Laparotomy.

Results: CRP test sensitivity was 85.00%, specificity was 80.67%, PPV was 73.91% and NPV was 88.89% to detected the obstruction with strangulation when using a cutoff value of 60 mg/L. 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 when using a cutoff value of 4.5 mmol/L.

Conclusions: Serum CRP and D-lactate can be useful and reasonable markers for predicting strangulation in cases of acute intestinal obstruction in an emergency setting.

Keywords: CRP, D-lactate, Intestinal obstruction

INTRODUCTION

Intestinal obstruction is one of the commonest clinical problems encountered in surgical practice. One of the grave complications of intestinal obstruction is strangulation, 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.¹ The most common cause of bowel gangrene secondary to mechanical obstruction is

strangulated hernia in India and post operative adhesions in developed countries.

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.

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.^{2,3}

This study was conducted to emphasise the significance of early estimation of rise in serum C- reactive protein and D- lactate levels followed by early intervention which helps in reducing the morbidity and mortality caused by bowel gangrene following obstruction.

METHODS

Study type: Hospital based prospective study. **Study duration:** August 2017 to July 2018. **Study place:** Department of General surgery JLN Medical College, Ajmer. **Study population:** The study was performed on 50 patients admitted in J.L.N. Hospital, Ajmer in various surgical units with diagnosis of acute intestinal obstruction and underwent explorative Laparotomy.

Inclusion criteria

All patients aged 15-90 years with suspicion of acute intestinal obstruction and underwent exploratory Laparotomy in the emergency operation at J.L.N. Hospital, Ajmer.

Exclusion criteria

- Patients with coexisting medical illnesses, such as chronic kidney disease, any cardiac disease, diabetes mellitus and coagulopathy.
- Patients with any intra-operative finding apart from simple or strangulated bowel obstruction.
- Acute intestinal obstruction was diagnosed by history, clinical examination and imaging modalities.

Data collection

Based on the various intra-operative finding causing acute intestinal obstruction all patients divided into two groups-

- A – Obstruction with strangulation.
- B – Obstruction without strangulation.

Blood investigation was send for serum C- reactive protein (CRP) and serum D-lactate.

Measurement of serum CRP levels

- Quantitative assessment of serum CRP was done using human CRP kit based on the principle of solid-phase enzyme-linked immunosorbent assay.
- For calculation of sensitivity and specificity cut of value of CRP was use 60 mg/L.

Measurement of serum D-lactate levels

- D-lactate was estimated by using the D-lactate assay kit based on the principle of proportionate color generation as a result of oxidation of D-lactate by D-lactate dehydrogenase.
- For calculation of sensitivity and specificity cut of value of D-lactate was use 4.5 mmol/l.

Statistical analysis

All data were analyzed on EPI-info statistical software. Qualitative data was expressed in the form of proportion. Quantitative data was expressed in mean $\pm$ SD. Qualitative data was compared by Chi square test. Unpaired t test was used to infer the difference in means.

RESULTS

The mean age in group A was 46.25 ± 18.29 years and mean age in group B was 47.03 ± 19.12 years. All male patients were in group A and 73.33% patients were male & 26.67% patients were female in group B. Socio-demographic variable in both group were comparable.

Table 1: Serum C- reactive level.

	Group A (Intestinal obstruction with strangulation)		Group B (Intestinal obstruction without strangulation)	
	Mean	SD	Mean	SD
CRP level	110.50	27.14	38.96	17.40
P value	0.001			

As per above Table shows that mean CRP level was 110.50 ± 27.14 mg/dl in group A and mean CRP level was 38.96 ± 17.40 mg/dl in group B. The mean CRP level differences in both groups were statistically significant.

Table 2: sensitivity and specificity for elevated serum CRP level.

CRP level	Group A (obstruction with strangulation)	Group B (obstruction without strangulation)
Increased	17	6
Normal	3	24
Total	20	30
P value	0.001	
Sensitivity	85.00%	
Specificity	80.67%	
Positive predictive value	73.91%	
Negative predictive value	88.89%	

As per above Table shows that CRP test sensitivity was 85.00%, specificity was 80.67%, PPV was 73.91% and NPV was 88.89% to detected the obstruction with strangulation when using a cutoff value of 60 mg/L.

Table 3: Serum D-lactate level.

	Group A (Intestinal obstruction with strangulation)		Group B (Intestinal obstruction without strangulation)	
	Mean	SD	Mean	SD
D-lactate	5.82	0.62	2.87	1.04
P value	0.001			

As per above Table shows that mean D-lactate level was 5.2 ± 0.62 mmol/L in group A and mean D-lactate level was 2.87 ± 1.04 mmol/L in group B. The mean D-lactate level differences in both groups were statistically significant.

Table 4: Sensitivity and specificity for elevated serum D-lactate level.

D-lactate	Group A (obstruction with strangulation)	Group B (obstruction without strangulation)
Increased	16	3
Normal	4	27
Total	20	30
P value	0.001	
Sensitivity	80.00%	
Specificity	90.00%	
Positive predictive value	84.30%	
Negative predictive value	87.10%	

As per above Table shows that 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 when using a cutoff value of 4.5 mmol/L.

Table 5: TLC.

	Group A (Intestinal obstruction with strangulation)		Group B (Intestinal obstruction without strangulation)	
	Mean	SD	Mean	SD
TLC	16025.50	4669.45	8560.66	3187.38
P value	0.001			

As per above Table shows that mean TLC level was 16025.50 ± 4669.45 mm³ group A and mean TLC level was 8560.66 ± 3187.38 mm³ group B. The mean TLC level differences in both groups were statistically significant.

Table 6: Sensitivity and specificity for elevated TLC level.

TLC	Group A (obstruction with strangulation)	Group B (obstruction without strangulation)
Increased	16	4
Normal	4	26
Total	20	30
P value	0.001	
Sensitivity	80.00%	
Specificity	86.67%	
Positive predictive value	80%	
Negative predictive value	86.67%	

As per above Table shows that TLC test sensitivity was 80.00%, specificity was 56.67%, PPV was 80.00% and NPV was 86.67% to detected the obstruction with strangulation.

DISCUSSION

Hospital based prospective study was conducted on 50 patients admitted in J. L. N. Hospital, Ajmer in various surgical units with diagnosis of acute intestinal obstruction and explorative laparotomy done. Acute intestinal obstruction was diagnosed by history, clinical examination and imaging modalities. Aims of our study was to evaluate role of serum C – reactive protein and serum D – lactate in combination as markers of bowel strangulation.

Strangulation 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 in many cases.^{4,5}

In a study by Demir et al done for identifying factors predicting the need for surgery, elevated CRP was significantly associated with bowel gangrene and an underlying predictive value for the need of surgery.⁶ Another study by Lin et al for evaluation of risk factors for intestinal gangrene identified that elevated serum CRP was associated with bowel gangrene.⁷

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 nonischemia group.⁸ In our study CRP test sensitivity was

85.00%, specificity was 80.67%, PPV was 73.91% and NPV was 88.89% to detected the obstruction with strangulation. Mean CRP level was 110.50 ± 27.14 mg/dl in group A and mean CRP level was 38.96 ± 17.40 mg/dl in group B. The mean CRP level differences in both groups were statistically significant.

Ajay K pal et al observed that serum values of CRP were significantly higher in patients with strangulated bowel obstruction as compared with simple bowel obstruction (116 vs 40 mg/L respectively, $p < 0.05$). For predicting strangulation, using a cutoff value of 60 mg/L for CRP, the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were 87.5, 58.3, 48.3, and 91.3% respectively.⁹

In our study mean D-lactate level was 5.2 ± 0.62 mmol/L in group A and mean D-lactate level was 2.87 ± 1.04 mmol/L in group B. 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.

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.⁹ In our study mean TLC level was 16025.50 ± 4669.45 mm³ group A and mean TLC level was 8560.66 ± 3187.38 mm³ group B. The mean TLC level difference in both groups were statistically significant. Pal et al observed that insignificant ($p > 0.05$), the values of TLC were also higher in the strangulated bowel obstruction (10,500 vs 16,800 per μ L).⁹

CONCLUSION

Serum CRP and D-lactate can be useful and reasonable markers for predicting strangulation in cases of acute intestinal obstruction in an emergency setting.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Markogiannakis H, Messaris E, Dardamanis D, Pararas N, Tzertzemelis D, Giannopoulos P, et al. Acute mechanical bowel obstruction: clinical presentation, etiology, management and outcome. *World J Gastroenterol*. 2007;13(3):432-7.
2. Stolberg L, Rolfe R, Gitlin N, Merrit J, Mann L, Linder J. D-lactic acidosis due to abnormal flora. *N Engl J Med*. 1982;306(22):1344-8.
3. Perlmutter DH, Boyle JT, Campos JM, Egler JM, Watkins JB. D-lactic acidosis in children: an unusual metabolic complication of small bowel resection. *J Pediatr* 1983;102(2):234-8.
4. Hilal K, Koçdor MA, Astarcioglu H, Fadiloğlu M. Serum tumor necrosis factor- α , glutamate and lactate changes in two different stages of mechanical intestinal obstruction. *Turk J Gastroenterol* 2003;14(2):115-9.
5. Block T, Nilsson TK, Björck M, Acosta S. Diagnostic accuracy of plasma biomarkers for intestinal ischaemia. *Scand J Clin Lab Invest*. 2008;68(3):242-8.
6. Demir IE, Ceyhan GO, Friess H. Beyond lactate: is there a role for serum lactate measurement in diagnosing acute mesenteric ischemia? *Dig Surg*. 2012;29(3):226-35.
7. Lin YP, Lee J, Chao HC, Kong MS, Lai MW, Chen CC, Chen SY, Luo CC. Risk factors for intestinal gangrene in children with small-bowel volvulus. *Pediatr Gastroenterol Nutr*. 2011;53(4):417-22.
8. Van Noord D, Mensink PB, de Knecht RJ, Ouwendijk M, Francke J, van Vuuren AJ, Hansen BE, Kuipers EJ. Serum markers and intestinal mucosal injury in chronic gastrointestinal ischemia. *Dig Dis Sci*. 2011;56(2):506-12.
9. Pal AK, Ansari MM, Islam N. Combination of Serum C – reactive protein and D-lactate: Predictors of Strangulation in Intestinal Obstruction. *Panam J Trauma Crit Care Emerg Surg*. 2016;5(3):134-9.

Cite this article as: Dhoon R, Kumawat S, Soni M L, Rohella MK, Sharma S, Karosia V. A prospective study of serum C-reactive protein and D-lactate levels for early prediction of strangulation in intestinal obstruction. *Int Surg J* 2019;6:2510-3.