Diagnostic Value of Lactate Levels in Acute Abdomen Disorders

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Received: 3 June 2013 / Accepted: 13 September 2013 / Published online: 26 September 2013
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Abstract The supply of oxygen is limited in certain intra abdominal conditions due to direct vascular invasion or inflammatory process, resulting in high lactate levels. Aim of this study was to find the predictive value of lactate levels in the peritoneal fluid (PF) and blood of patients with acute abdomen. The study comprised of fifty patients with acute abdominal conditions, admitted in emergency ward of tertiary care hospital, thirty patients were with surgical abdomen (group I) and twenty patients with non surgical abdomen (group II). Lactate was estimated in PF and blood on Blood Gas Analyzer (NOVA, M-7). The mean lactate levels in PF were significantly higher in group I as compared to group II (14.65 ± 1.195 vs. 5.92 ± 0.97 mmol/L, $p < 0.001$). There was no significant difference in blood lactate levels in both the groups. When PF and blood lactate levels were compared within groups, we found that PF levels were significantly higher than blood in group I (14.65 ± 1.195 vs. 3.85 ± 0.54 mmol/L, $p < 0.001$) but not in group II (5.92 ± 0.97 vs. 4.36 ± 0.95 mmol/L). Diagnostic value was obtained using ROC curve. Cut off values obtained for PF lactate, difference and ratio of PF and blood lactate (≥ 6.4 mmol/L, ≥ 3.3 and ≥ 2.1 respectively) are at very high degree of sensitivity and specificity. So it can be useful marker of surgical emergency in patients with acute intra abdominal pathology, especially in clinically ill patients or in whom physical examination is not yielding because of neurologic disorders or unresponsiveness.

Keywords Acute abdomen · Blood lactate · Peritoneal fluid lactate

Introduction

Acute abdomen is a condition where there is sudden abdominal pain with associated signs and symptoms that focus attention to abdominal causes. The proper management of these patients requires a timely decision of intervention. The decision, whether/when to operate a patient with equivocal evidence of acute surgical abdomen, still remains a challenge. It depends on the evaluation of patient's history, physical findings, laboratory data and imaging studies.

The raised lactate level is an early sign of tissue hypoxia. It has been shown to be a marker for mesenteric ischemia as well and in acute intestinal conditions like appendicitis. Lactate levels have been more specific than C reactive protein or leukocyte count [1–3]. Normally lactate levels in blood (0.5–2.5 mmol/L) and peritoneal fluid (PF) are same, but in intra abdominal disease conditions resulting into low oxygen tension, causes greater increase in lactate levels in PF than blood [4]. So simultaneous estimation of PF and blood lactate can be helpful in detecting acute intra abdominal pathology [5]. There is very little data available where lactate levels are used as marker for need of intervention in acute abdomen disorders, so the present study was planned to find the predictive value of lactate in correlation with severity of disease.

Materials and Methods

Fifty patients (both gender and >15 years) presenting with acute abdominal problems in Emergency Ward of tertiary

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Table 1 Acute abdominal disorders with surgical and non surgical emergencies, $n = 50$

S. No.	Group I	$n = 30$	Group II	$n = 20$
1	Gangrenous gut	4	Acute gastroenteritis	1
2	Perforation	23	Pancreatitis	17
3	Secondary peritonitis	3	Sub acute intestinal obstruction	2

care hospital were included in the study and divided into two groups. group I: Thirty patients with acute surgical abdomen (gangrenous gut, perforation of hollow viscous, secondary peritonitis) and group II: Twenty patients with non surgical acute abdomen (acute gastroenteritis, pancreatitis, sub acute intestinal obstruction) Burns or trauma patients were not included in the study.

Heamogram, random blood sugar, renal and liver function tests, urine routine, X-ray chest and abdomen and ultrasound of whole abdomen were carried out. Arterial blood and PF samples were collected simultaneously for lactate estimation in all the patients. In group I, PF was aspirated immediately upon opening the peritoneum before manipulation of intra abdominal contents whereas in group-II abdominal paracentesis was used to obtain PF by using 18 or 20 gauge disposable needles inserted aseptically just through abdominal wall in right or left iliac fossa and fluid was withdrawn by gentle suction The blood and PF lactate was analyzed on Blood Gas Analyzer (NOVA, M-7, Biomedical, USA).

Study protocol was approved by *ethical committee* of the institution.

Statistical Analysis

Mean and standard error of mean (SEM) were computed. The difference between two groups was seen by applying t test. The level of significance considered was 0.05. Diagnostic value was obtained using receiver operating characteristics (ROC) curve.

Results

Group I included patients with gangrenous gut, perforation of hollow viscous, secondary peritonitis and group II included patients with acute gastroenteritis, pancreatitis and sub acute intestinal obstruction. Table 1 shows number of patients with each emergency. Table 2 shows lactate levels were significantly higher in PF as compared to blood levels in surgical patients (group I), similarly in group II, lactate levels were raised in PF compared to blood levels but the difference was not significant. Lactate levels in PF

Table 2 Mean lactate levels in PF and blood

Groups	Lactate levels (mmol/L $\pm$ SEM)	
	PF	Blood
I	14.65 $\pm$ 1.19* [#]	3.85 $\pm$ 0.54
II	5.92 $\pm$ 0.97	4.36 $\pm$ 0.95

* $p < 0.001$ PF lactate versus blood lactate of group I

[#] $p < 0.001$ PF lactate of group I versus group II

Table 3 Difference and ratio of mean lactate levels in PF and blood

Group	Difference between PF and blood lactate levels (mmol/L $\pm$ SEM)	Ratio of PF and blood lactate
I	10.80 $\pm$ 0.975*	3.8 [#]
II	1.56 $\pm$ 0.174	1.37

* $p < 0.001$ difference of group I versus group II

[#] $p < 0.01$ ratio of group I versus group II

Fig. 1 ROC analysis of difference of lactate levels in PF and blood

were significantly higher in group I compared to group II. There was no significant difference in blood lactate levels of both the groups. Difference and ratio of PF and blood lactate levels was ≥ 3.0 in all patients in group I and was significantly ($p < 0.001$) higher in group I compared to group II, Table 3.

ROC Analysis

The cut-off point for PF lactate is ≥ 6.4 mmol/L with sensitivity 93.33 % and specificity 90.0 %. Positive predictive value (PPV) and negative predictive value (NPV) at this point is 93.33 and 90.0 % respectively. No cut-off value could be determined for blood lactate, so this variable is not able to discriminate between the groups. Figure 1 shows ROC analysis of difference of lactate levels in PF and blood. The best cut-off value is ≥ 3.3 mmol/L, the

Fig. 2 ROC analysis of ratio of lactate levels in PF and blood

sensitivity and specificity is 100 %. PPV and NPV at this cut-off point is also 100 %. Figure 2 shows ROC analysis of ratio of lactate levels in PF and blood. The cut-off value is ≥ 2.1 , the sensitivity and specificity is 96.67 and 95.05 % respectively. PPV and NPV at this cut-off point is also 96.67 and 95.05 % respectively.

Discussion

The routine preoperative evaluation of patients with potential intra abdominal catastrophe has led to invention of variety of diagnostic tests. The clinical parameters including physical examination, radiological and laboratory findings are done to detect intestinal strangulation. None of the parameters alone or in combination proved to have desirable predictive value. Increased plasma lactate concentration is a recognized danger signal often found in cases of shock, septicemia, hepatic and renal failure and diabetic ketoacidosis [6–8]. The peritoneal lavage has been reported to be useful adjuvant in the evaluation of patients with abdominal pain whereas ascetic fluid lactate levels have been helpful for diagnosis of spontaneous bacterial peritonitis [9, 10].

Intra abdominal diseased conditions results into low oxygen tension due to direct vascular invasion or inflammatory process. Under anaerobic conditions, the cytochrome system is unable to function as an intermediate in the transfer of hydrogen to molecular oxygen. So, reduced coenzyme nicotinamide adenine dinucleotide (NADH) accumulates and gets oxidized with lactate dehydrogenase to produce lactate. This will lead to lactate acidosis with significant increase in lactate/pyruvate ratio. Normally lactate levels in blood and PF are equal but in intra abdominal diseased conditions, these levels increase more in PF than in the blood. As there are chances of metabolic

acidosis in these patients, hence the difference and ratio of PF to blood lactate is more significant. In previous studies also significantly higher level of PF lactate as compared to plasma lactate were reported in patients with gangrenous bowel, perforation of hollow viscous and peritonitis. They also reported that difference between PF and blood was ≥ 1.5 mmol/L, predicted the presence of acute intra abdominal pathology with 100 % accuracy [5, 9, 11].

In the present study, best cut off value obtained for PF lactate is ≥ 6.4 mmol/L, for difference and ratio of PF and blood lactate is ≥ 3.3 and ≥ 2.1 respectively. All the values are at very high degree of sensitivity and specificity, making it a good diagnostic marker which can signify the presence of acute intra abdominal pathology with surgical emergency that needs urgent laparotomy. The purpose of this study was to augment the diagnostic accuracy of routine clinical assessment of such patient.

Our findings suggest that the calculated difference and ratio between PF and plasma lactate levels is a valuable diagnostic marker for patients in whom the diagnosis of acute abdomen is not obvious. Clinical trials in USA (2010) also showed that increased PF/serum lactate ratio is an important marker even for relaparotomy and post surgical complications [12].

Conclusion

Although the decision, whether/when to perform surgery is largely subjective and based on professional experience. Cut off values obtained for PF lactate, difference and ratio of PF and blood lactate are at very high degree of sensitivity thus increasing its diagnostic value. So lactate estimation is sensitive, non invasive, time and cost effective marker for acute abdominal disorders and could be useful tool for the surgeon in decisional process.

References

1. Caglagan F, Cakmak M, Caglayan O, Cavusoglu T. Plasma D-lactate levels in diagnosis of appendicitis. *J Invest Surg.* 2003;16:233–7.
2. Block T, Nilsson TK, Bjdrick M, Acosta S. Diagnostic accuracy of plasma biomarkers for intestinal ischaemia. *Scand Clin Lab Invest.* 2008;68(3):242–8.
3. Meyer ZC, Schreinemakers JMJ, van der Laan L. The value of C-reactive protein and lactate in the acute abdomen in the emergency department. *World J Emerg Surg.* 2012;7:22. doi:10.1186/1749-7922-7-22.
4. Delaurier GA, Ivey RK, Johnson RH. Peritoneal fluid lactic acid and diagnostic dilemma in acute abdominal diseases. *Am J Surg.* 1994;167(3):302–5.
5. Mittal DK, Sexena RK, Choudary A, Kumar A. Peritoneal fluid lactic acid diagnostic dilemmas in acute abdominal diseases. *Ind J Surg.* 2001;63:298–304.

6. Lange H, Toivola A. Warning signals in acute abdominal disorders. Lactate is the best marker of mesenteric ischemia. *Lakartidningen*. 1997;19(20):1893–6.
7. Bakker J, Schieveld SJ, Brinkert W. Serum lactate level as an indicator of tissue hypoxia in severely ill patients. *Ned Tijdschr Geneesk*. 2000;144:377–83.
8. Lange J. Usefulness of plasma lactate concentration in the diagnosis of acute abdominal disease. *Eur J Surg*. 1995;160:381–4.
9. Baillay RL, Gildorf RB. Diagnostic peritoneal lavage in evaluation of acute abdominal disease. *South Med J*. 1990;83:422–7.
10. Filiz AL, Aladag H, Levhi M, Sucuulu L. The role of D-lactate I differential diagnosis of acute appendicitis. *J Invest Surg*. 2010;23(4):216–23.
11. Demircan M, Cetin S, Uquralp S, Karaman, Sezgin N, Gozukara EM. Plasma D-Lactic acid level: a useful marker to distinguish perforated from acute simple appendicitis. *Asian J Surg*. 2004;27(4):303–5.
12. Ospedale S, Giovanni B. Peritoneal/serum lactate ratio in relaprotomy. *Surgical Complication Clinical Trials*. 2010. Philadelphia, USA.