Original Article

A New Way in Diagnosis of Acute Mesenteric Ischemia

M. Rasti MD*, E. Refaei, A .Rahmani MD*****

ABSTRACT

Background: Despite advances over the past few decades in operative techniques and perioperative managements, acute mesenteric ischemia (AMI) is astonishingly associated with high mortality rate (around 75 to 90 percent). The diagnosis of mesenteric ischemia remains a challenge. Presently, there is no quick and easy test (or combination of tests) which are available, with few side effects, high positive and negative predictive values, which can be early indicative of acute bowel ischemia. In our study we suggest intestinal serosal color change as an early diagnostic sign.

Methods: This experimental single blinded study was done on 16 male rabbits. Every day we operated five rabbits with one of them as control. In case group superior mesenteric artery was ligated and thirty minutes later, observers who did not know the control and cases, inspected and scored the color changes of intestinal loops in rabbits. All of cases, which were reported as cyanotic or pale, supposed to be ischemic. The time from the ligation to color change was recorded.

Results: Superior mesenteric artery was ligated in 12 rabbits (cases). Three rabbits were used as controls. Color changes indicative of AMI (pale or cyanosis) appeared in nine case rabbits (75 percent of cases), 2 were pale and 7 were cyanotic. There were no false positive in our study and all of controls were true negative. Therefore sensitivity was about 75% and specificity was 100 percent. Intestinal serosal color change appeared in 1 hour after occlusion and infarction occured after 6 hours.

Conclusion: The result of this study shows that serosal color change is an indicator of occlusion of superior mesenteric artery in rabbits. Considering the similarity between human and rabbits with respect to intestinal loops, data regarding the time profile and color changes can be extrapolated to human as an indicator of occlusion and a diagnostic test of superior mesenteric ischemia for early diagnosis of this pathology.

Key words: Acute Mesenteric Ischemia, Diagnostic Tests, Occlusion.

Acute mesenteric ischemia (AMI) is astonishingly associated with high mortality rate (around 75 to 90 percent), despite advances over the past few decades in operative techniques and perioperative managements1-2. This is mainly because most of mesenteric vascular diseases are asymptomatic which causes delay in diagnosis and treatment3. Patients are always presented with abdominal pain that is out of proportion to physical findings. The lower involvement of peripheral nervous system unfortunately causes underestimating the severity of condition and delay in diagnosis4. Mesenteric infarction is a pathology, which encountered fairly often in elderly patients. The coexistence of other diseases makes its prognosis worse1-5. So the high mortality of this disorder is multifactorial in nature1-6. The diagnosis of mesenteric ischemia remains a challenge7, many diagnostic tests are recommended such as duplex ultrasonographic scanning which shows the proximal segments of vessels. But the quality of imaging reduces in obese patients (where these patient are frequently obese) and intestinal gas or ileus often disturb the view[4-7]. Computed tomography scanning (CT scan) is another test that cannot accurately prove or exclude the diagnosis of acute mesenteric ischemia; only in rare cases of acute mesenteric vein thrombosis, CT scan may be accurate[8]. Although mesenteric infarction in animals displayed a significant increase in serum total CPK, LDH, SGOT and alkaline phosphates[9],

*Assistant Professor, Department of Surgery, Isfahan University of Medical Sciences, Isfahan, Iran.
** Intern, Department of Surgery, Isfahan University of Medical Sciences, Isfahan, Iran.
***Assistant Professor, Department of Internal Medicine, Isfahan University of Medical Sciences, Isfahan, Iran.
Correspondence to: Dr Mehdi Rasti, Department of Surgery, Al-Zahra Medical Center, Isfahan, Iran.

peaks of these enzymes elevation occur at least 12 hours after injury which signals irreversible necrosis of intestine, so they can not be considered as early diagnostic signs of AMI[10 -11]. A management plan incorporating the earlier and more liberal use of angiography together with preoperative and postoperative papaverin infusion into the superior mesenteric artery (SMA) can lower the mortality associated with this catastrophic disorder to less than 50 percent[7,12,13]. With extensive laparatomy and inspection of SMA and SMV, mortality decreases to 20 percent[14]. But in view of the fact that, in most centers, it is impossible to perform emergency selective angiography of the SMA[5], and only 1 percent of laparatomies are performed annually for intestinal infarction[15], most of these patients will be operated after development of peritoneal signs or gastrointestinal bleeding which are often late findings in gut infarction[11]. Some surgeons suggest that diagnostic laparatomy must be done in all of patients with suspicious AMI; but by this fact that most of these patients have poor clinical conditions, progressive atherosclerotic disease and average age of at least 70, general anesthesia and surgery have high mortality risk for them[13-15]. Presently there is no quick and easy test (or combination of testes) with minor side effects and acceptable positive and negative predictive values[8]. In our experience we have noticed that intestinal serosal color change may be an early diagnostic sign for AMI. We saw in a patient who was under diagnostic peritoneal lavage (DPL) for etiology, that small bowel serosal color has changed; so this idea was evolved that if serosal color change occur earlier than occlusion (less than 6 hours), it may be used as a diagnostic sign. As for DPL, this procedure (bowel look-up) can be performed under local anesthesia. This minor procedure can be performed by a small incision below the umbilicus and draging a small bowel loop out of the abdomen and inspecting it for any color change indicative of AMI. Since majority of occlusive accidents occur at the proximal segment of SMA, therefore serosal color changes can be observed in all loops. We named this procedure as DBL (diagnostic bowel looking). DBL can be performed for a patient suspicious of AMI when other possible diagnoses have been ruled out. Absence of bowel pulse is not a reliable indicator for AMI in DBL due to the possible presence of incisional tightness around the extruding loop when it is dragged out of the abdomen. Bowel movement may exist long after the occlusion in mesenteric artery or vein, therefore its presence does not rule out the AMI. It is not clear whether serosal color change is of sufficient magnitude to be distinguishable for surgeon and how long after occlusion definite color changes take place. This study was designed to evaluate the extent of serosal color changes which is of sufficient magnitude to be distinguishable by the surgeon and the latency of this sign relative to the golden time in a sample of male rabbits with induced AMI.

Materials and Methods

This experimental single blinded study was done on 16 male rabbits. We used rabbits because their intestinal anatomy is similar to human. In the first day one of rabbits was anaesthetized by interaperitoneal injection of lidocaine and ketamine. Then we fixed it at supine position and operated it with a vertical incision in midline. The observers (year 4 medical students) saw the normal color of intestinal serosa. Then we ligate the superior mesenteric artery. After 30 minutes intestinal loops changed in color. Therefore we recorded this time as the approximate time for serosal color change after ligation of superior mesenteric artery. Other rabbits were operated on in three days. Every day we operated five rabbits, ligated superior mesenteric artery in four cases and the fifth rabbit was used with intact artery as control. Thirty minutes after ligation of superior mesenteric artery the observers inspected the intestinal loops continuously for a period of one hour without knowing the case or control. They gave score for color changes in intestinal loops from 1 to 5. Score one considered as pale, 2 and 3 as normal, 4 and 5 as cyanotic. Cases which were reported as cyanotic or pale, supposed as ischemia. The time from the ligation to the serosal color change was recorded. Mean, mode, median and quartile of quantitative data were reported. Inter observers agreement was determined by calculating the kappa value for analysis of ordinal grades.

Results

Time to color change was 42.1 ± 8.59 minutes. The minimum, maximum, median, and mode for time to color change were 30, 57.4, 41.5, and 39 minutes respectively. Quartiles for 25, 50, and 75 percentage were 39, 41.5, and 47 minutes respectively. Time to color change followed a bell shaped normal distribution.

In this study we operated 15 rabbits and ligated superior mesenteric artery in 12 rabbits (cases). Three rabbits were used as controls. Color changes indicative of AMI (pale or cyanosis) appeared in nine case rabbits (75 percent of cases), 2 were pale and 7 were cyanotic.

We had five observers who graded rabbits from pale to cyanosis by ordinal scale (1=pale, 2 and 3= normal, 4 and 5= cyanosis). As shown in table 1 the inter observers agreement was meaningful.

Table 1. Interobservers agreement for raters. Data are kappa values for agreement.

	Observer			
Observer	2	3	4	5
1	0.895	0.572	0.895	0.895
2		0.681	0.791	0.791
3			0.483	0.483
4				1.000

All agreements were significant at 0.001 levels.

In Case group, rabbits which were reported cyanotic or pale, were true positive so we had 9 true positives and rabbits in cases group with normal report were false negative, so we had 3 false negatives. There were no false positive in our study and all of controls were true negative .Therefore in our study sensitivity is about 75 percent and specificity is 100 percent. Positive predictive value in this study is 100 percent and negative predictive value is about 50 percent.

Discussion

Mesenteric ischemia has been increasingly diagnosed in the past 25 years. It is suspected that this higher incidence is due to a number of factors, including aging of population and the widespread use of intensive care unites wherein extraordinary cardiopulmonary supports save patients who would previously have died of their primary disease but now survive and become susceptible to acute mesenteric ischemia[12,13]. The diagnosis of mesenteric vascular pathology still remains a challenge because it is rare and usually present with non-specific symptoms[2,15]. Survival after superior mesenteric ischemia is related directly to early diagnosis based on emergency mesenteric angiography. Early mesenteric angiography is the gold standard to diagnosis and manage mesenteric vascular ischemia[10,12]. Immediate laparatomy or angiography with subsequent thrombolysis are the treatment options available[16,17]. Since angiography is nearly impossible in emergency condition[4] so we need a diagnostic test to evaluate patients with suspected acute or chronic mesenteric vascular disease[2].

Figure 1. Normal serosal color of an intestinal loop.

In this study serosal color change has been used as an indicator of occlusion of superior mesenteric artery. The results shows that up to one hour after occlusion of the artery color change appears at least in eighty five percents of cases which is recognizable for amateur observers who have no experiment about surgery. Although the estimated sensitivity of 75% for DBL is lower than that for angiography but still it is higher than the other diagnostic testes[3, 6-10]. Therefore considering the limitation of emergent angiography, DBL procedure can be used instead, with 75 percent confidence, to prove or rule out AMI. If the surgeon sees color change during DBL, the pathology will be proved with 100 percents specificity and patient will be operated as early as possible.

In addition to cost-effectiveness, this procedure is relatively low-risk for the patient. Difficulty in repairing of fascia is one of the problems that may be appears after DBL which can be solved by longer incision and better procedure. Some cases in this study had pale color change. It has been reported that in sudden occlusion of superior mesenteric artery bowel may appears pale or cyanotic when the artery is initially in a state of constriction[12]. This paleness is completely different from normal pink color.

Since intestinal anatomy of rabbits is very similar to human and intestinal serosal color change appears in 1 hour after occlusion and infarction occurs after 6 hours[13] therefore these time profiles and color changes can be used confidently in human during occlusion of superior mesenteric artery.

Acknowledgment

The authors are grateful to Dr M. Talaei for his kind help in designing the study and analysis of data.

References

1. Ouriel K, Green RM. Arterial diseases .In: Schwartz SI, Shires G Tom, Spencer C, Daly JM, Fischer JE, Galloway AC ,editors .principle's of surgery .New York .Mc Graw-Hill, 1999: 966
2. R.H.Geelkerken, J.H.VanBokel. Mesenteric vascular disease: a review of diagnostic method and therapies. Cardiovascular surgery 1995; 3(3):247-260
3. Flinn WR, Bergan JJ. Visceral ischemic syndromes: obstruction of the superior mesenteric artery, celiac axis and inferior mesenteric artery. In: Subiston DC, Duke JB, Lyerly HK, editors. Subiston text book of surgery: The biological basis of modern surgical practice. Philadelphia, Pennsylvania: W.B. Sanders company, 1997:1750-1753
4. Perris S, Lotti R, procaccianete F, Gabrielle F, Nardi M, Amendolara M, Golap Citon G. Intestinal infarction .Retrospective clinical study. Chir Ital 2001 Jan -Feb; 53(1): 45-56
5. Chblert S, Porcheron J, Balique J G. Management of acute intestinal arterial ischemia. J Chir (Paris) 1999 Oct; 136(3): 130-5
6. Alpern MB, Glazer GM, Francis IR. Ischemic or infracted bowel: CT finding. Radiology 1988 Jan; 166 (1Pt1):149-52
7. Ammatur C, De Rosa A, Salzano A, Morra C, Bassiu C, Cerrato D, Eliso E, Cacaae A. Intestinal infarction: report of 98 cases. Chir Ital 2001 Jan- Feb; 53(1):57-64
8. De Tome G, Mrzano D, Salvatore P, Cerza F, De Cesar E, Giacovazzo M , Matelote P, Antonucci M. Enzymatic and metabolic changes in peripheral serum after superior mesenteric artery ligation in dogs . Ital J surgery Sci 1983; 13(4): 269-273
9. Graber GM, Caffery PJ, Readron MJ, Curley Cp, Ackerman NB, Harmon JW. Chang in serum total creatin phosphokinase (CPK) and its isoenzymes caused by experimental ligation of the superior mesenteric artery. ANN surge 1981 Apr; 193(4):499-505
10. Boley SJ, Feinstein FR, Sammartano R, Brandt LJ, Sprayregense. New concepts in management of emboli of the superior mesenteric artery. Surge Gynecology obstetric 1981 Oct; 153(4):561-9
11. Pase E, Vollmar JF, Hutschenreiter S, Schoenberg MH, Keble R, scholel E. Mesenterial infarct .New aspect of diagnosis and therapy . Chiug 1988 Dec; 59(12):828-835
12. Arvey I Rogers, Steven David. Intestinal blood flow and diseases of vascular impairment .In: Haubrich WS, et al. Gastroenterology. Philadelphia WB Sunders company, 1995:1212-1232
13. Tabriziani, Hussein, Shieu, Aileen, Frishman, William .H; Brandt; Lawrence J. Drug therapies for mesenteric vascular disease .Heart disease 2002Nov-Sep; 4(5):306-314
14. Josef E. Fischer, Elliot Fegelman, Jay Johannigman. Surgical complications .In: Schwartz SI, Shires G Tom, Spencer FC, Daly JM, Fischer JE, Galloway AC, editors. Principle of surgery. New York-Mc Graw- Hill 1999; 441-442
15. Vincent David C, Kasmers Andris. Acute mesenteric ischemia. Current opinion in cardiology 1999 Sep; 14(5): 453-454

16. Sternbergh WC III, Ramee SR, DeVun DA, Money SR .Endovascular treatment of multiple visceral artery paradoxical emboli with mechanical and pharmacological thrombolysis. Journal of endovascular treatment 2000; 7:155-60
17. Kwauk ST, Bartlett JH, Hayes P, Chow KC. Intra_ arterial fibrinolytic treatment for mesenteric arterial embolus: a case report .Can J surg 1996; 39:163-6.