

Role of Multidetector Computed Tomography in Patients of Acute Mesenteric Ischaemia and its Comparison with Clinicosurgical Outcome: A Cross-sectional Study

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ABSTRACT

Introduction: Acute mesenteric ischaemia is an abdominal emergency occurring in nearly 1% of patients presenting with acute abdomen. Early diagnosis is very important for the improved survival of the patient. Acute mesenteric ischaemia frequently presents with non specific features such as vomiting, loose stools and abdominal distension. The classical triad of fever, haematochezia and abdominal pain is seen in only 30% of the patients so, it is difficult to diagnose clinically. Multidetector Computed Tomography (MDCT) is gold standard and first line test to diagnose intestinal ischaemia.

Aim: To assess the efficacy of MDCT in the diagnosis of acute mesenteric ischaemia and to compare its outcome with surgical and/or clinical findings.

Materials and Methods: In this cross-sectional descriptive study conducted from 1st November 2018 to 31st May 2020, MDCT was performed on 40 patients (23 male; 17 female, age range: 28-93 years). Axial and reconstructed images of each patient were evaluated for evidence of bowel wall thickening, bowel wall attenuation, abnormal wall enhancement, bowel dilatation, mesenteric stranding, ascites, solid organ infarcts, pneumatosis intestinalis or portomesenteric gas, and mesenteric arterial or venous thrombosis. Multidetector CT findings were compared with the surgical findings and clinical outcome. Results were expressed in terms of frequency and percentages.

Results: Out of 40 patients, most common cause of acute mesenteric ischaemia was arterial thrombosis, seen in 20 patients (50%) while 13 patients (32.5%) had portomesenteric venous thrombosis and 7 (17.5%) patients were diagnosed with non occlusive mesenteric ischaemia. CT finding of bowel wall thickening and bowel dilatation however non specific were seen in majority of patients (62.5% and 70%, respectively). Mesenteric fat stranding and ascites were seen in 95% and 77.5% cases respectively. Specific signs of acute mesenteric ischaemia includes hypoenhancing and non enhancing bowel walls seen in 27 patients (67.5%). Pneumatosis intestinalis and portomesenteric pneumatosis in 20% patients. A total of 27 patients underwent surgery and 13 patients were managed conservatively. On comparing the CT findings with intraoperative/histopathological findings, accuracy of MDCT in the diagnosis of acute mesenteric ischaemia in this study was 96.39%.

Conclusion: MDCT should be the first line imaging modality to diagnose acute mesenteric ischaemia and to exclude other causes of acute abdomen. It is an excellent and fast modality to diagnose bowel ischaemia, as it can visualise both the bowel and mesenteric changes as well as accurately depict the mesenteric vasculature.

INTRODUCTION

Acute mesenteric ischaemia is a rare life threatening condition with high mortality rate so, it requires early diagnosis and prompt treatment [1-3]. X-ray has limited role in diagnosing Acute Mesenteric Ischaemia (AMI). No lab study is sufficiently accurate to identify acute mesenteric ischaemia however, elevated serum L-lactate and D-dimer may assist [4]. Elevated serum lactate levels >2 mmol/l have been associated with irreversible intestinal ischaemia [5]. MDCT is a widely accepted primary investigation of choice in suspected patients of acute mesenteric ischaemia [6,7]. It is the most rapid, specific, time efficient, objective and informative imaging technique. With the advanced technology of MDCT, multiple images can be acquired in a single tube rotation. It is the most sensitive and specific diagnostic tool with a sensitivity of 64%-96% and specificity of 92%-100% in the diagnosis of AMI [8].

Various causes of acute mesenteric ischaemia includes mesenteric arterial embolism/thrombosis, mesenteric venous thrombosis, and non occlusive mesenteric ischaemia [8]. Acute mesenteric ischaemia causes various abnormalities in bowel wall, mesenteric vessels, and in mesentery depending on duration, site, cause and extent of

ischaemia. During interpretation, radiologists should assess the bowel wall, its thickness and attenuation; luminal dilatation; mesenteric vessels; mesentery; and other organs [9-11]. Acute mesenteric arterial occlusion is typically caused by a thromboembolism associated with cardiovascular problems followed by arterial thrombosis, which accounts for 60%-75% (arterial embolism 40%-50%; arterial thrombosis, 20%-30%) of all acute bowel ischaemia cases [12-14]. Thrombosis of the mesenteric vein can be primary or secondary to portal hypertension or infection or can be associated with various hypercoagulopathy states [15].

Mesenteric venous obstruction does not typically lead to severe bowel ischaemia; however, thrombosis of the mesenteric vein accounts for 5%-10% of acute bowel ischaemia. Bowel ischaemia and infarction can occur with a reduction of mesenteric blood supply without vascular occlusion, which is called non occlusive mesenteric ischaemia or infarction. This type of bowel ischaemia accounts for 20%-30% of all acute mesenteric ischaemia, with mortality rates from 30% to 93% [16,17]. In this study, the accuracy of MDCT in diagnosing acute mesenteric ischaemia and its comparison with clinicosurgical outcome was done.

Keywords: Acute abdomen, Arterial thrombosis, Non occlusive

MATERIALS AND METHODS

It was a cross-sectional descriptive study conducted on all the patients with suspicion of acute mesenteric ischaemia referred for MDCT in the Department of Radiodiagnosis, Dayanand Medical College and Hospital, Ludhiana, India from 1st November 2018 to 31st May 2020. Institutional Ethical Committee approval was obtained.

Inclusion criteria: Patients with findings of acute mesenteric ischaemia on MDCT abdomen were included in the study.

Exclusion criteria:

- Patients with alternative diagnosis of acute abdomen on imaging.
- Patients who refused to participate in the study or allergic to contrast.

Study Procedure

Informed consent was obtained from all the subjects before study. The clinical history regarding the onset of symptoms, clinical progression of disease and spectrum of findings were recorded. MDCT of the patients was performed on Siemens 128 slice CT scan machine. Non contrast images were acquired followed by acquisition of arterial and venous phase images after giving intravenous water soluble contrast (omnipaque).

Scan duration was 90 seconds with scanning delay time of 30 seconds for arterial phase and 60 seconds for venous phase. Amount of contrast given was 1.5 mL/kg body weight at the rate of 3 mL/sec with a pump injector.

MDCT Features

The features on images were obtained as follows:-

- Bowel wall thickness: Thickness of >3 mm in small or large bowel was considered as a criteria for bowel wall thickening.
- Bowel wall enhancement
- Increased bowel wall attenuation on non contrast imaging
- Bowel dilatation: Small bowel diameter of more than 2.5 cm and large bowel diameter of more than 6 cm was considered as criteria for bowel dilatation.
- Arterial or venous thrombosis
- Mesenteric fat stranding
- Free fluid/ascites
- Intestinal pneumatosis
- Portomesenteric venous gas
- Solid organ infarction: Infarcted organ shows as non enhancing hypodense wedge shaped areas at the periphery.

STATISTICAL ANALYSIS

The radiological data describing the vascular and intestinal findings were collected systematically and the diagnostic findings of acute mesenteric ischaemia were compared with surgical data and histopathological findings. Results were expressed in terms of frequency and percentages.

RESULTS

A total of 40 patients were included in this study with age ranging from 28-93 years. Mean age of the study population was 56.6±17.9 years. Maximum patients (n=9, 22.5%) were between 41-50 years of age followed by 7 (17.5%) each between 31-40 years and 61-70 years of age, 6 (15%) were in the age group of 51-60 years and above 80 years of 3 (7.5%) were between 71-80 years of age and only 2 (5%) were less than 30 years of age. There were 23 (57.5%) males and rest 17 (42.5%) were females.

A total of 38 (95%) patients presented with pain in the abdomen, 26 (65%) with constipation, 20 (50%) with vomiting and another 20 (50%) presented with abdominal distension [Table/Fig-1].

On the basis of clinical complaints, clinical diagnosis of acute mesenteric ischaemia was made only in 13 patients (32.5%) [Table/Fig-2].

Clinical complaints	No. of cases (N=40)	Percentages (%)
Pain abdomen	38	95
Constipation	26	65
Vomiting	20	50
Abdominal distension	20	50
Blood in stools	03	7.5

[Table/Fig-1]: Various clinical presentations.

Clinical diagnosis	No. of case (N=40)	Percentages (%)
Subacute intestinal obstruction	14	35
Acute mesenteric ischemia	13	32.5
Acute pancreatitis	4	10
Acute gastritis	3	7.5
Acute abdomen	2	5
Acute colitis	1	2.5
Chronic liver disease	1	2.5
Inguinal hernia	1	2.5
Intestinal perforation	1	2.5

[Table/Fig-2]: Clinical diagnosis.

A total of 24 (60%) patients were having leucocytosis. Serum lactate was done in 16 patients. A total of 9/16 (56.2%) patients showed serum lactate >2 mmol/L. However, it is seen only in advanced stage of acute mesenteric ischemic. Co-morbidities such as hypertension, chronic liver disease, atrial fibrillation, Systemic Lupus Erythematosus (SLE) and deep vein thrombosis were seen in 27/40 patients, out of which majority 21 (52.5%) were hypertensive.

CT Findings

Out of 40 patients, bowel wall thickening was 7 (17.5%) patients. Thinned out bowel wall was seen in seven patients (17.5%). In 8 (20%), bowel wall thickness was normal.

A total of 8 (20%) showed hyperattenuating walls on non contrast CT and the remaining patients showed normal wall attenuation. On contrast enhanced CT scan, 13 (32.5%) patients showed non enhancing walls, 14 (35%) showed hypoenhancing walls. Hyperenhancing walls were seen in 3 (7.5%) whereas, 10 (25%) patients showed normal wall enhancement on comparing with non affected bowel loops [Table/Fig-3].

Wall enhancement	No. of cases (N=40)	Percentages (%)
Hypoenhancing	14	35
Non enhancing	13	32.5
Hyperenhancing	3	7.5
Normal enhancement	10	25

[Table/Fig-3]: CT findings (bowel wall enhancement on post contrast images).

A total of 28 (70%) were having dilatation of bowel lumen on CT abdomen whereas, 12 (30%) were having normal calibre of the bowel. Arterial thrombosis was seen in 20 (50%) patients. 13 (32.5%) patients were having venous thrombosis and 7 (17.5%) were diagnosed as non occlusive mesenteric ischaemia.

In this study, 38 (95%) patients showed changes in mesentery in the form of fat stranding and 31 (77.5%) patients showed free fluid in peritoneal cavity. A total of 8/40 patients (20%) showed features of pneumatosis intestinalis and portomesenteric pneumatosis on imaging. Renal/splenic/liver infarcts were seen in 13 (32.5%) patients. Pneumoperitoneum was seen in 7 (17.5%).

Out of 40 patients, 27 (67.5%) underwent resection anastomosis, the remaining 13 (32.5%) were managed conservatively with heparin or antiplatelets.

Out of all 27 patients who underwent surgery, peroperative findings and histopathology reports were correlating with CT findings in 26 patients with CT accuracy of 96.29%. In one patient (3.7%),

condition and segment of involved gut loop was not concordant with CT findings [Table/Fig-4].

Peroperative and histopathological findings	Number of cases (N=27)
Concordance	26
Not concordance	1
CT accuracy	96.29%

[Table/Fig-4]: Concordance of peroperative and histopathological findings with CT findings.

On four weeks follow-up of 27 operated patients, 24 were stable and three patients died due to postoperative complications.

Thirteen patients underwent conservative management, 10 were stable on four weeks follow-up whereas, two patients died due to associated co-morbidities. One patient died due to delayed presentation to the hospital with a delay of more than 12 hours.

DISCUSSION

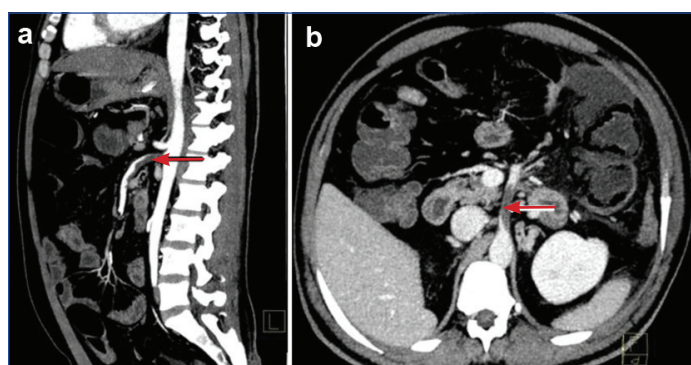
Acute mesenteric ischaemia is a life threatening condition. It has high mortality rate of approximately 50%-90% as it lacks specific signs and specific lab tests [8]. Mesenteric ischaemia is classified as either acute or chronic. Causes of acute mesenteric ischaemia include arterial embolism, arterial thrombosis, venous thrombosis, and non occlusive mesenteric ischaemia. Arterial causes are more common than the venous causes [8]. In this study, also, most common cause of acute mesenteric ischaemia is arterial thrombosis (50%) followed by venous thrombosis (32.5%) and non occlusive mesenteric ischaemia (17.5%).

The prognosis of acute mesenteric ischaemia depends on the time from diagnosis to initiation of management. Mortality rate is markedly less with immediate management (0%-10%). It increases to more than 50% with a delay of 6-12 hours, and further increase to nearly 100% with a delay of more than 24 hours after onset of symptoms. Therefore, early diagnosis and prompt management are mandatory in patients with acute mesenteric ischaemia [8]. One patient in this study died due to delayed presentation with delay of more than 12 hours. Hence, imaging plays an important role in the diagnosis of acute mesenteric ischaemia.

Contrast enhanced MDCT has high accuracy for the diagnosis of acute mesenteric ischaemia. CT also helps to differentiate mesenteric ischaemia from other causes of acute abdomen.

Majority of the patients (95%) presented with abdominal pain, 50% presented with abdominal distension and 50% with vomiting. These findings are in close approximation with study done by Alhan E et al., in which 90.6% patients had pain abdomen, 48.5% presented with vomiting and 26.1% presented with abdominal distension [18].

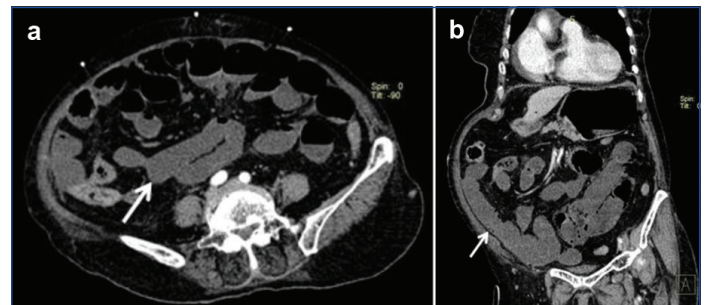
Arterial thrombosis was the most common cause of acute mesenteric ischaemia, seen in 50% patients [Table/Fig-5]. Second most common cause was venous thrombosis (32.5%) followed by non occlusive mesenteric ischaemia (17.5%). These findings are almost similar to study done by Barmase M et al., in which 43.5 % of cases of acute mesenteric ischaemia were due to arterial causes and 31.2% were due to venous causes [19].



[Table/Fig-5]: Contrast enhanced (a) saggital and (b) axial CT scan shows hypoattenuating thrombus in SMA (Red arrow in a, white arrow in b).

In this study, bowel wall thickening was seen in 62.5% patients, thinning of bowel wall was seen in 17.5% patients and normal wall thickness was seen in 20% patients. In an another study done by Kirkpatrick ID et al., in which 84.6% patients showed bowel wall thickening [20]. The difference may be due to difference in sample size.

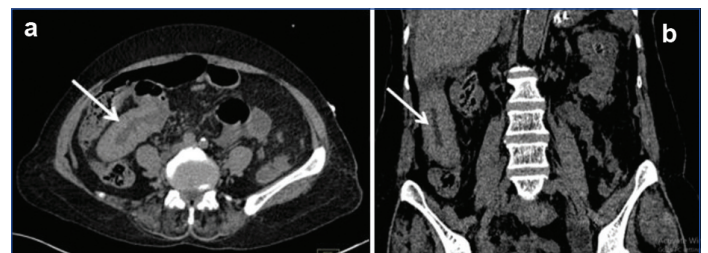
In those patients who had arterial thrombosis (20/40), bowel wall thinning was seen in (7/20) patients (35%) which represents irreversible ischaemic injury [Table/Fig-6].



[Table/Fig-6]: Contrast enhanced (a) axial and (b) coronal CT shows non enhancing and papery thin walls in the ileum (arrows).

Luminal dilatation on CT scan was seen in 70% of patients. It is in agreement with a study done by Al-Azzazy MZ et al., which showed bowel dilatation in 71% patients [21].

Hyperattenuating bowel wall on non contrast CT is a specific sign of ischaemia. It indicates haemorrhagic infarction which was seen in 20% cases which strongly correlates with study done by Al-Azzazy MZ et al., [21] showing increased bowel wall attenuation in 21% patients [Table/Fig-7].



[Table/Fig-7]: Non contrast (a) axial and (b) coronal CT scan shows hyperattenuating walls of small bowel in right hemi abdomen (arrows).

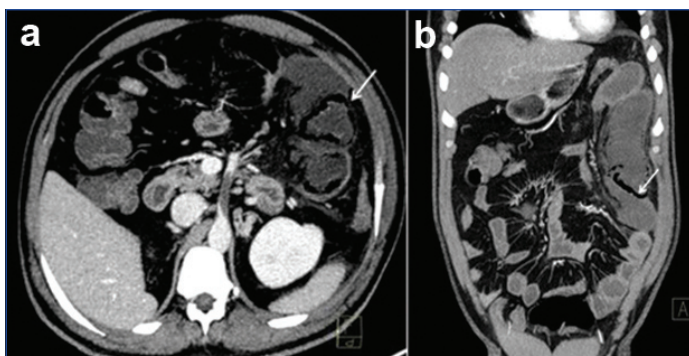
Absence of wall enhancement or hypoenhancement indicates reduced blood flow and is a specific finding for acute mesenteric ischaemia. In this study, it was seen in 67.5% cases and is in agreement with a study done by Al-Azzazy MZ et al., in which it was present in 71.4% cases [21]. Comparison with other studies is shown in [Table/Fig-8] [19,21-23].

Authors	Number of cases	Diagnostic accuracy of CT scan (%)
Aschoff AJ et al., 2009 [22]	28	96.4
Barmase M et al., 2011 [19]	16	100
Al-Azzazy MZ et al., 2012 [21]	26	92.8
Mohey N and Riad MM et al., 2020 [23]	58	100
Present study	27	96.39

[Table/Fig-8]: Comparison of diagnostic accuracy of MDCT with previous studies [19,21-23].

Mesenteric stranding and ascites are caused by congestion or reperfusion and is a non specific finding. However, presence of mesenteric stranding and ascites in absence of reperfusion in cases of arterial thrombosis may represent irreversible ischaemia. In this study, mesenteric stranding was seen in 95% and ascites in 77.5% cases. It is almost similar to study done by Kirkpatrick ID et al., in which 88.4% patients had mesenteric stranding and 73% patients had ascites [20].

Pneumatosis intestinalis and portomesenteric pneumatosis are a poor prognostic factor of acute mesenteric ischaemia. It indicates transmural infarction of bowel with or without perforation. It was seen in 20% patients in our study [Table/Fig-9]. Solid organ infarct was seen in 32.5% patients in this study.



[Table/Fig-9]: Contrast enhanced (a) axial and (b) coronal CT showing gas within the bowel wall which is non enhancing and dilated (arrows).

Out of 40 patients, 27 underwent surgery and 13 were managed conservatively. Out of 27 patients, findings of MDCT were correlating with histopathological report in 26 patients with CT accuracy of 96.29% in diagnosing acute mesenteric ischaemia. It is close to the study done by Aschoff AJ et al., which concluded that CT scan had accuracy of 96.4% in diagnosis of acute mesenteric ischaemia [22].

One patient showed false negative findings on MDCT in which imaging findings were not correlating with surgical/histopathological findings. On CT scan, diagnosis of subacute intestinal obstruction was made secondary to adhesion/band with no imaging features of acute mesenteric ischaemia. However, patient was found to have ischaemic changes intraoperatively for which resection anastomosis was done and ischaemic pathology was confirmed on histopathology. The reason for this might be increased time interval between acquisition of scan and surgery. Dual energy CT can be a better modality in cases of acute mesenteric ischaemia as ischaemic bowel can be better assessed because of attenuation difference between ischaemic and perfused bowel, thereby, increasing the accuracy, sensitivity and specificity to diagnose acute mesenteric ischaemia in early cases.

Limitation(s)

The incidence rates presented in this study are not overall incidences of the disease as they represent the hospital incidence only. Another limitation is that without a control group, it is not possible to calculate the specificity of MDCT in acute mesenteric ischaemia.

CONCLUSION(S)

Acute mesenteric ischaemia is primarily a disease of older individuals with no overall sex preponderance. Early diagnosis and prompt management of acute mesenteric ischaemia are mandatory to improve the patients prognosis so, contrast enhanced MDCT should be the first line imaging modality. It allows visualisation of early signs of bowel ischaemia and infarction. A high index of suspicion with early diagnosis with MDCT may improve the patient's survival and reduce the overall mortality rate.

REFERENCES

- [1] Haghighi PH, Lankarani KB, Taghavi SA, Marvasti VE. Acute mesenteric ischaemia: Causes and mortality rates over sixteen years in southern Iran. *Indian J Gastroenterol*. 2008;27(6):236-38.
- [2] Wadman M, Syk I, Elmståhl S. Survival after operations for ischaemic bowel disease. *Eur J Surg*. 2000;166(11):872-77.
- [3] Tsai MS, Lin CL, Chen HP, Lee PH, Sung FC, Kao CH. Long-term risk of mesenteric ischaemia in patients with inflammatory bowel disease: A 13-year nationwide cohort study in an asian population. *Am J Surg*. 2015;210(1):80-86.
- [4] Kougias P, Lau D, El Sayed HF, Zhou W, Huynh TT, Lin PH. Determinants of mortality and treatment outcome following surgical interventions for acutemesenteric ischaemia. *J Vasc Surg*. 2007;46:467-74.
- [5] Nuzzo A, Maggiori L, Ronot M, Becq A, Plessier A, Gault N, et al. Predictive factors of intestinal necrosis in acute mesenteric ischaemia: Prospective study from an intestinal stroke center. *Am J Gastroenterol*. 2017;112:597-605.
- [6] Bolog N, Popiel A, Oancea I, Mangrau A, Beuran M, Nicolau E. Multidetector row spiral CT (MDCT) in bowel related non traumatic abdominal emergencies. *J gastroenterol* 2003;12:319-24.
- [7] Frauenfelder T, Wildermuth S, Marincek B, Boehm T. Nontraumatic emergent abdominal vascular conditions: Advantages of multidetector row CT and three-dimensional imaging. *Radiographics*. 2004;24:481-96.
- [8] Kanasaki S, Furukawa A, Fumoto K, Hamanaka Y, Ota S, Hirose T, et al. Acute mesenteric ischaemia: multidetector CT findings and endovascular management. *Radiographics*. 2018;38(3):945-61. Doi: 10.1148/rg.2018170163. PMID: 29757725.
- [9] Wiesner W, Khurana B, Ji H, Ros PR. CT of acute bowel ischaemia. *Radiology*. 2003;226:635-50.
- [10] Macari M, Balthazar EJ. CT of bowel wall thickening: Significance and pitfalls of interpretation. *AJR*. 2001;176:1105-16.
- [11] Macari M, Megibow AJ, Balthazar EJ. A pattern approach to the abnormal small bowel: Observations at MDCT and CT enterography. *AJR*. 2007;188:1344-55.
- [12] Bradbury AW, Eritenden J, McBride K, Ruckley CV. Mesenteric ischaemia: A multidisciplinary approach. *Br J Surg*. 1995;82:1446-59.
- [13] Mansour MA. Management of acute mesenteric ischaemia. *Arch Surg*. 1999;134:328-30.
- [14] Stoney RJ, Cunningham CG. Acute mesenteric ischaemia. *Surgery*. 1993;114:489-90.
- [15] Grendel JH, Ockner RK. Mesenteric venous thrombosis. *Gastroenterology*. 1982;82:358-72.
- [16] Clotz S, Vestring T, Rötter J, Schmidt C, Scheld HH, Schmid C. Diagnosis and treatment of non occlusive mesenteric ischaemia after open heart surgery. *Ann Thorac Surg*. 2001;72:1583-86.
- [17] Trompeter M, Brazda T, Remy CT, Vestring T, Reimer P. Non-occlusive mesenteric ischaemia: Etiology, diagnosis, and interventional therapy. *Eur Radiol*. 2002;12:1179-87.
- [18] Alhan E, Usta A, Çekiç A, Sağlam K, Türkylmaz S, Cinel A. A study on 107 patients with acute mesenteric ischaemia over 30 years. *International Journal of Surgery*. 2012;10(9):510-13.
- [19] Barmase M, Kang M, Wig J, Kochhar R, Gupta R, Khandelwal N. Role of multidetector CT angiography in the evaluation of suspected mesenteric ischaemia. *Eur J Radiol*. 2011;80(3):e582-87.
- [20] Kirkpatrick ID, Kroeker MA, Greenberg HM. Biphasic CT with mesenteric CT angiography in the evaluation of acute mesenteric ischaemia: Initial experience. *Radiology*. 2003;229(1):91-98. Epub 2003 Aug 27.
- [21] Al-Azzazy MZ, Hasan DI, Sherbeni ME, Gameel AM. Multidetector CT and CT angiography in mesenteric ischaemia. *The Egyptian Journal of Radiology and Nuclear Medicine*. 2012;43(3):337-45.
- [22] Aschoff AJ, Stuber G, Becker BW, Hoffmann MH, Schmitz BL, Schelzig H, et al. Evaluation of acute mesenteric ischaemia: Accuracy of biphasic mesenteric multi-detector CT angiography. *Abdom Imaging*. 2009;34(3):345-57.
- [23] Mohey N, Riad MM. Reliability of multi-detector CT in the assessment of mesenteric ischaemia using basic images. *The Medical Journal of Cairo University*. 2020;88:335-44. Doi: 10.21608/mjcu.2020.93995.

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