

Value of Plain Abdominal Radiograph, Ultrasound and Computerized Tomography in the Diagnosis of Intestinal Obstruction

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Abstract

- Background** The diagnosis of mechanical intestinal obstruction is sometimes very challenging especially in the absence of previous abdominal surgery or obstructed hernia and there are limited studies comparing or evaluating the usefulness of plain abdominal x-ray, ultrasonography, and computerized tomography (CT) in intestinal obstruction.
- Objective** To compare the efficacy of plain abdominal x-ray, ultrasound and CT in the diagnosis of intestinal obstruction. Also, to assess ultrasound value and usefulness in pregnant women and critically bed ridden patients with intestinal obstruction.
- Methods** In this prospective study with signs and symptoms of mechanical intestinal obstruction, a total of sixty two patients were investigated by plain x-ray, ultrasound, CT scan and the findings were compared with reference to the presence or absence of obstruction, the level, site, cause and strangulation of bowel for a period of eight years (2009-2016). The final diagnosis was obtained by surgery and only those with proved intestinal obstruction per-operative were included in the study.
- Results** Out of the sixty two patients (41 males and 21 females) included with an age incidence (22-65 yr), 58 had mechanical intestinal obstruction (50 had small bowel obstruction and 8 had large bowel obstruction), of the remaining 4 patients; 2 had mesenteric vascular occlusion and 2 had pseudo-obstruction. The level and site of obstruction was correctly predicted in 91.9% on CT, in 82% on ultrasound and 90.3% on plain film. CT was the best 85.4% to both, ultrasound 24% and plain film 8% in determining the cause of obstruction. Regarding strangulation of bowel, CT was superior while plain film was the least informative with the ultrasound in between.
- Conclusion** CT is the best tool for the diagnosis, strangulation of the bowel and detecting cause of intestinal obstruction and recommended to be the investigation of choice in equivocal cases. Ultrasound is the best and sole investigation in pregnant women and critically bed ridden patients especially in early cases.
- Keywords** Intestinal obstruction, plain abdominal x-ray, ultrasound, CT scan.
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List of abbreviations: none.

Introduction

Abdominal radiography can be entirely normal in patients with complete, closed loop, or strangulating

obstruction ⁽¹⁾.

Therefore; if the patient clinical profile and the results of physical examination are highly consistent with intestinal obstruction or in cases where plain x-rays films are inconvenient

as in pregnancy or critically ill bed ridden patients or being normal or equivocal and little informative or more details are needed, in this case more sophisticated investigations are needed greatly and these would be namely a more advanced imaging studies, these would be ultrasound and computerized tomography (CT) scan ⁽¹⁻⁸⁾.

This need requires to prove that these imaging modalities are sensitive, specific and accurate in intestinal obstruction when ordered, performed properly and interpreted by expert radiologist. This is supported by two prospective clinical trials ^(9,10).

Sonography criteria have been established for small bowel, colonic obstruction and even ileus through: simultaneous observation of distended and collapsed bowel segment, free peritoneal fluid, inspissated intestinal contents, paradoxical peristalsis, highly reflective fluid within the bowel lumen, bowel wall edema between serosa and mucosa, a fixed mass of a peristaltic, fluid filled, dilated intestinal loops.

Ultrasound is well suited to pregnant women and critically ill patients because it is safe and can be performed at the bed side, the risk associated with transport to the radiology suite is avoided. Given that ultrasound is relatively inexpensive, is easy and quick to perform, and often can provide a great deal of information about the location, nature, severity of the obstruction and possibility of strangulation, it should be employed early in the evaluation of all patients with intestinal obstruction ⁽¹¹⁻¹³⁾.

CT scan has several advantages over the plain film, ultrasound especially with contrast; it can ascertain the level of obstruction, it can assess the severity of the obstruction and determine its cause, it can detect closed loop obstruction and early strangulation. The CT scan findings, that every surgeon should be aware of which, can help in assessing precisely cases of intestinal obstruction with or without strangulation are; it can show thick adhesive bands, collapsed distal bowel loops and absence of air in the large bowel, distended fluid filled loops with air fluid levels,

hyperemia, bowel wall thickening in cases of strangulation and ischemia, free fluid in the peritoneum. It may show the site of obstruction and the cause, it also can detect inflammatory or neoplastic processes both outside and inside the peritoneal cavity, it can visualize small amounts of intraperitoneal air or pneumatosis cystoides intestinalis not seen in conventional films ^(14,15).

The aims of this study were to evaluate the efficacy of plain abdominal x-ray film, ultrasound, and CT scan in the diagnosis of intestinal obstruction. In addition to assess the value of plain films, ultrasound and CT scan in determining the level, site, cause and the presence or absence of strangulation. Also, to evaluate the importance of ultrasound in the assessment of intestinal obstruction in pregnant women, and bed ridden, critically ill patients with signs and symptoms of intestinal obstruction.

Methods

Patients

A prospective study with a total number of 62 patients presented to Al-Imamein Al-kadhimein Medical City from October 2009 to October 2016 with the diagnosis of intestinal obstruction.

Exclusion criteria

- a. Previous abdominal surgery.
- b. Obstructed hernia.
- c. Paralytic ileus.

After workup on those selected patients through history taking, clinical examination and the proper investigations, only those with high suspicion of intestinal obstruction were included and this group is even downsized to those who required surgery and proved of have one type of intestinal obstruction.

Methods

All the necessary detailed data about each patient clinical presentation were covered.

The 62 patients elected for the study underwent the following investigations in addition to the regular investigations.

1. Plain abdominal x-ray film both in erect and supine position for the diagnosis and to help figure out the level and, the involved part and the cause of obstruction. For the features of strangulation; thickened small bowel loops, mucosal thumb printing, pneumatosis cystoides intestinalis, or free peritoneal air.
2. Ultrasound done looking for:
 - A. The line of demarcation between collapsed and distended loop.
 - B. Bowel wall edema between serosa and mucosa for possibility of ischemia.
 - C. A fixed mass of a peristaltic fluid filled dilated intestinal loops.
 - D. Presence of free peritoneal fluid.
 - E. Inspissated intestinal contents.
 - F. Paradoxical peristalsis.
 - G. High reflective fluid within the bowel lumen.
3. Computerized Tomography, carried out for each patient included looking for;
 - A. It can ascertain the level of obstruction.
 - B. It can assess the severity of the obstruction and determine its cause.
 - C. It can detect closed loop obstruction and early strangulation.

The CT scan findings that every surgeon should be aware of which can help in assessing precisely cases of intestinal obstruction with or without strangulation are;

 - A. It can show thick adhesive bands.
 - B. Collapsed distal bowel loops and absence of air in the large bowel.

- C. Distended fluid filled loops with air fluid levels, hyperemia, bowel wall thickening in cases of strangulation and ischemia.
- D. Free fluid in the peritoneum.
- E. It may show the site of obstruction and the cause.
- F. It also can detect inflammatory or neoplastic processes both outside and inside the peritoneal cavity.
- G. It can visualize small amounts of intraperitoneal air or pneumatosis cystoides intestinalis not seen in conventional films.

Those 62 patients were compared and proved with reference to per-operative findings regarding the presence or absence of intestinal obstruction, the level of obstruction and the cause and as mentioned earlier the final diagnosis was obtained by surgery and only those with intestinal obstruction were included.

Results

Sixty-two patients were included in this study. Forty-one of them were male patients while twenty-one of them were female patients only. Fifty-eight (58) out of 62 (93.5%) patients had mechanical intestinal obstruction. Of those 58 patients, 50 patients (86.2%) had small intestinal obstruction and the rest 8 patients (13.9%) had large bowel obstruction. Regarding the remaining four patients; two of them has mesenteric vascular occlusion and the other 2 patients had pseudo-obstruction (Ogilvie's syndrome) (Table 1). Regarding diagnosis and level of obstruction, the accuracy of x-ray was 96.55%, ultrasound 87.93%, CT scan 98.27% (Table 2).

Table 1. The cause of intestinal obstruction in the 62 patients included in this study

Cause of Obstruction	Number of Patients (total 62)
Mechanical intestinal obstruction	58 (93.54%)
Small bowel mechanical	50 (80.64%)
Large bowel mechanical	8 (12.90%)
Mesenteric vascular ischemia	2 (3.22%)
Pseudo-obstruction	2 (3.22%)

Table 2. The Accuracy of each investigation for the level and site of obstruction

Investigation	Number of patients	Diagnostic accuracy
x-ray	56	96.55%
Ultrasound	51	87.93%
CT Scan	57	98.27%

For identifying the cause, the CT scan was superior 85.4%, followed by Ultrasound 24%, and the least was x-ray 8% (Table 3).

While the results about the possibility of strangulation was best seen on CT scan 75.8%,

followed by ultrasound 17.7% in early cases and the least informative and difficult to interpret by the surgical team and its result was 0% (Table 4).

Table 3. The Accuracy of investigations modalities for the cause of obstruction

Investigation	Number of patients	Accuracy
X-ray	5	8.62%
Ultrasound	15	25.86%
CT scan	53	91.37%

Table 4. The Accuracy of the investigation modalities in strangulation obstruction

Investigation	Number of patients	Accuracy
X-ray	0	0%
Ultrasound	11	18.96%
CT scan	47	81.04%

Discussion

For a long time, abdominal x-ray films, because of its low cost and availability, has long been considered the first choice of investigations in patients with intestinal obstruction ⁽¹⁶⁾, but the organizational structure of the abdomen is responsible for overlapping images, low resolution, difficult to show clear signs, site of obstruction, cause of obstruction assessment of blood circulation and strangulation which make it difficult on the surgeon to interpret ⁽⁷⁾. This group of abdominal x-ray films of the site of obstruction, causes, strangulation and their accuracy rates were 90.3%, 8%, and 0% respectively. The opinion about strangulation on plain film is very difficult to be seen.

Mechanical intestinal obstruction is one of the common surgical acute abdomen and if not handled properly the transition to intestinal strangulation the mortality can be as high as

20-30 %; therefore, early diagnosis and surgical treatment can significantly reduce the mortality ⁽¹⁷⁾.

Clinically in intestinal obstruction one do not need only to know whether obstruction is there but more needed to determine the exact location of obstruction, cause and whether strangulation is present.

For the site and diagnosis, plain film was 96.55%, ultrasound 87.93% and CT 98.27% correct, which make it superior in this regard.

It is worth mentioning that ultrasound diagnosis of intestinal obstruction when fluid is still in the bowel is relatively good in comparison plain film when air accumulates in the bowel and becomes distended with air.

When the bowel loops are distended with fluid it makes a good acoustic window and in this situation the intestinal structure, mucosal folds, the ileocecal valve, mucosal thickening,

the cause of obstruction and intestinal contents can be clearly shown in addition to closed loop syndrome ^(2,7,8,11-15).

In the early phase of intestinal obstruction when the loops at this time show no obvious expansion of intestinal gas and filled with fluid and in comparison, to x-ray can be superior to plain film in finding changes in intestinal expansion and bowel movement and blood supply which can clearly suggest intestinal obstruction ⁽¹⁸⁾.

For all the advantages and usefulness of ultrasound in diagnosis, working on the cause, finding the type of obstruction (mechanical or adynamic), ileus follow-up, blood supply and strangulation, the ultrasound is the superior tool of investigation in a case of suspected intestinal obstruction during pregnancy and critically ill patients ^(19,20).

With the wide application of CT scan the current diagnosis of intestinal obstruction has developed into a fast and easy proven method ⁽²¹⁾. It clearly shows the obstructed bowel and

its adjacent mesentery, peritoneal cavity anatomy structure, thus contributing to obstruction site ⁽²²⁾. CT scan can also observe the lesion, revascularization situation, see if the wall thickening of 5 mm scan cuts, diffuse or localized adjacent mesenteric swelling, vague massive ascites and the prompt diagnosis strangulation ⁽²³⁾.

Several authors have recommended that patients with suspected small bowel obstruction and equivocal plain film should undergo CT scan before a small bowel contrast series ordered ^(3,6).

Prospective studies comparing the value of plain film, ultrasound and CT scan have demonstrated that the accuracy rates in the diagnosis of bowel obstruction regarding all the data about the diagnosis, site, level and strangulation were very close to the study results apart from the diagnosis of strangulation on plain films; see (Tables 5, 6, and 7) ^(14,15,24).

Table 5. Comparison of accuracy of the investigation modalities in determination of site and level between this study and other studies

Investigation	Current study	Megibow et al ⁽¹⁴⁾	Balthazar et al ⁽¹⁵⁾	Markogiannakis ⁽²⁴⁾
CT scan	96.55%	94.0%	93.0%	90.2%
Ultrasound	87.93%	83.0%	70.0%	69.1%
X-ray	98.27%	91.0%	60.0%	83.7%

Table 6. Comparison of accuracy of the investigation modalities in determination of cause of obstruction between this study and other studies

Investigation	Current study	Megibow et al ⁽¹⁴⁾	Balthazar et al ⁽¹⁵⁾	Markogiannakis ⁽²⁴⁾
CT scan	85.4%	85.3%	87.0%	86.3%
Ultrasound	24%	36.0 %	23.0%	27.7%
X-ray	8%	32.0%	7.0%	7.5%

Table 7. Comparison of accuracy of the investigation modalities in determination of strangulation and ischemia between this study and other studies

Investigation	Current study	Megibow et al ⁽¹⁴⁾	Balthazar et al ⁽¹⁵⁾	Markogiannakis ⁽²⁴⁾
CT scan	81.04 %	79.0%	84.0%	76.9%
Ultrasound	18.96%	75.0%	11.7%	10.5%
X-ray	0%	15.0%	5.3%	8.1%

This study concluded that CT scan is highly accurate method in the evaluation of intestinal obstruction especially for determining the level, cause and possibility of strangulation and should be the investigation of choice when the clinical, plain film, and ultrasound findings are equivocal.

Ultrasound is the investigation of choice in cases of intestinal obstruction in pregnant women and at the bedside when the patient is critically ill.

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Conflict of interest

None.

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