



Research Article

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A New Point of Care Ultrasound in disposition of patients with small bowel obstruction in Emergency Department

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ABSTRACT

To determine a disposition method for the patients with small bowel obstruction (SBO), Ultrasonography (US) was done before X-ray for the patients who had signs and symptoms of SBO by a perfected Emergency Medicine resident and their results were registered. Patients that had one of X-ray or US variables for SBO were admitted in observation unit for surgical consultation. Time between surgical consultation and operation was recorded. The criterion standard for diagnosis of SBO was abdominal surgery or computed tomography (CT). The patients who discharged from ED with nonsurgical treatment were followed until one month. Totally, 133 patients were evaluated with US that decrease bowel peristalsis was the most sensitivity (100%), but dilated bowel (>25 mm) had the most specificity (100%) for diagnosis of SBO. Emergent Surgery was done: 88% of patients with dilated bowel and 100% of patients with unstable vital signs. Urgent surgery was done; 80.9% of decrease bowel peristalsis. Patients without one of US variables and signs and symptoms of acute abdomen, discharged from ED after nonsurgical treatment and 100% of them were cured. A New Point of Care abdominal Ultrasound can help physicians to dispose SBO patients and time determination of surgery.

Keywords: Point of care ultrasound, Small bowel obstruction

INTRODUCTION

Small bowel obstruction (SBO) can be functional or mechanical and can be partial or complete (1). In partial obstruction patients will have gas passing, whereas patients with complete obstruction will haven't defecation or gas passing (1-3). 80% of all the main reasons of SBO are adhesions, hernias and malignancies (4-8). Other etiologies are volvulus, inflammatory bowel disease, intussusception, gallstones, pancreatitis, bezoars, fecalitis and intestinal atresia (4-7). Abdominal pain, abdominal distention, nausea and vomiting are the usual signs and symptoms of SBO (8,9). There are differential diagnosis with similar signs and symptoms for SBO (10). Therefore physical examination and history taking with abdominal X-ray (upright or left lateral decubitus and supine) are approved for SBO diagnosis (10-12) But X-ray is often non-diagnostic (10,13), therefore physicians need more imagination with CT scan for SBO diagnosis (12,13). CT scan is able to detect the cause and the level of SBO (14) and it is 85% to

100% sensitive (14,15).The characteristics of CT scan for bowel ischemia are consist of reduced bowel wall enhancement, wall thickening, mesenteric venous .Unfortunately, CT scan may not be accessible in some cities or towns so physicians have to transport patients to central city or other hospitals for doing CT scan. CT scan will be expensive and also the patients will expose to greater radiation and need more time(16,17). Ultrasonography (US) has the same as accuracy CT scan and MRI in the recent researches (17) and also CT scan can be economical and accessible in every town or city (18). The application of US for SBO is learned simply and applied in the emergency department (19). Thus physicians can substitute US for diagnosis of SBO (13, 16, 17).But nowadays managing for diagnosis and time for surgery are based on signs and symptoms, X-ray and CT scan results (18-24). So, we evaluated particular US variables (decrease bowel peristalsis, thick wall bowel, dilated bowel, free fluid) for determination the role of bedside US in diagnosis and disposition of SBO patients in the emergency department.

This study will be advanced our knowledge to determine a disposition method for the patients with SBO and physicians will be able to perform with high accuracy in all hospitals and towns very fast.

MATERIALS AND METHODS

This study was a postgraduate thesis which was sampled between October 1, 2014 and December 31, 2015. When an Emergency Medicine resident was in Emergency Department did all ultrasonography before X-ray for 12 hours in 15 days during each month. This research was performed at an urban academic ED with 54000 annual visits.

Participant physicians in this study were two assistant professors of Emergency Medicine and an Emergency Medicine resident who perfected a preparatory course on emergency US for small bowel obstruction by an assistant professor of Interventional Radiology within one month.

All of the patients which referred to the Emergency Department with abdominal pain, nausea, or vomiting, abdominal distention and constipation were qualified for participating in this research. In this study, exclusion criteria were patients with nasogastric (NG) tube and bloody vomiting or diarrhea and patients had co morbidity .

The patients who had signs and symptoms of SBO and one of the X-ray variables for SBO(multiple air-filled level and dilated loops of bowel) or one of the US variables for SBO (decrease bowel peristalsis, thick wall bowel, dilated bowel, free fluid), admitted in observation unit for surgery consult.US was done before X-ray by an Emergency Medicine resident. The US and X-ray results were registered in a questionnaire and also when abdominal surgery or CT (computed tomography) was done by surgeons, their results were registered in the above mentioned questionnaire. Time between surgical consultation and operation was recorded by the Emergency Medicine resident. Patients were followed until one month if they hadn't been done abdominal surgery or CT and discharged from ED with nonsurgical treatment.

The criterion standard for the diagnosis of SBO was abdominal CT scan that interpreted by assistant professors of Radiology and assistant professors of surgery that did abdominal surgery after admission in observation unit .Radiologists and Surgeons were blind to the US results.

Study measurements

US examinations were accomplished by using a Sonoscape (SSI 6000 and A 6, China) with a 3.5 and 5 MHTZ probe in the epigastr and periumblical of abdomen to diagnose for the attendance of fluid-filled, dilated bowel (>25 mm),thick wall bowel(>4mm), and decreased bowel peristalsis(22). In abdominal X-rays, multiple air-filled level and dilated loops of bowel were regarded as positive for a small bowel obstruction(22).

Data analyzes:

An Excel database was used for data gathering and analyzes was guided by using SPSS (V.15). All of the sensitivity, specificity, predictive value of US variables were estimated.

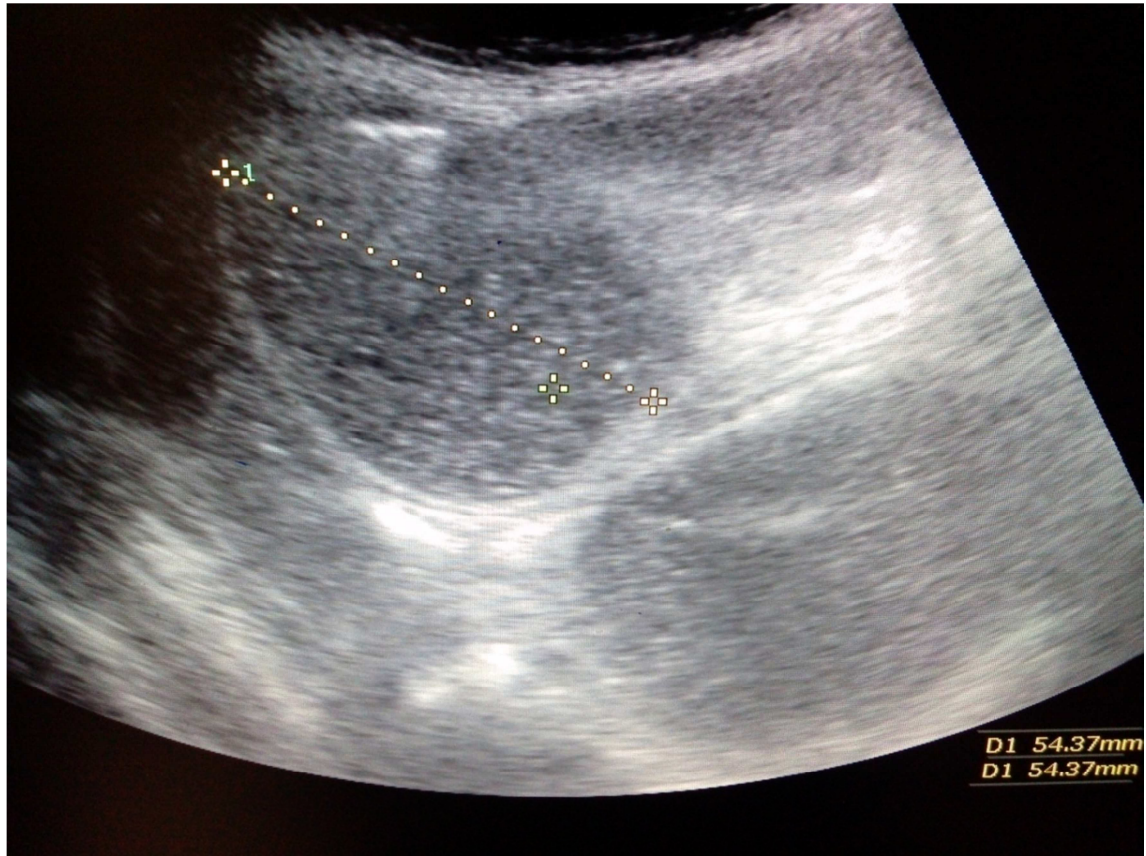


Figure 1: Patten of fluid-filled, dilated bowel (defined as >25 mm)



Figure 2: Patten of fluid-filled, dilated bowel (defined as >25 mm)

RESULTS

All of 133 patients which referred to the ED and were evaluated for SBO with US, when the Emergency Medicine resident was available, 64 patients from 133 patients were confirmed diagnose of small bowel obstruction disease by surgery and abdominal CT, and also 26 patients from 133 patients were as follows:

5 patients had acute appendicitis, 4 patients had colon cancer, 4 patients had ascitis, 4 patients had hernia, 4 patients had cholecystitis, 1 patient had abdominal aortic aneurysm, 2 patient had perforated peptic ulcer, 1 patient had chrons disease, 1 patient had bezoars and 43 patients had send to home after appropriate counseling and arrangement of follow-up, then they were followed until one month and signs and symptoms of SBO for all of them were resolved without surgical treatment.

Emergent Surgery was done: 88% of patients with dilated bowel and 100% of patients with unstable vital signs. Urgent surgery was done; 80.9% of decrease bowel peristalsis, 23% of thick wall bowel and 12 % of free fluid. Patients without one of US variables and signs and symptoms of acute abdomen, discharged from ED after nonsurgical treatment and 100% of them were be cured during one month. All of the sensitivity, specificity, predictive value of US variables are shown in table 1, 2, 3

Table1: Performance characteristics of US and X-ray for diagnosis of SBO

	Sensitivity	Specificity	+PV	-PV
US	100	78.5	82.4	100
Abdominal X-Ray	76.1	47.6	59.3	66.7

+/-PV: positive and negative predictive value

Table2: performance characteristics of ultrasound (US) for small bowel obstruction

	Sensitivity	Specificity	+PV	-PV
Dilated Bowel on US	97.7	100	100	97.7
Thick wall bowel on US	40.9	83.7	68	54.8
Decrease bowel peristalsis	100	67.4	75.9	100
Free fluid	4.5	88.4	28.6	47.5

+/-PV: positive and negative predictive value

Table3: performance characteristics of ultrasound (US) variables for SBO and time of surgery

	(Emergent surgery) Surgery was done in first hour of admission	(Urgent surgery) Surgery was done in first day of admission	Discharge from ED with nonsurgical treatment.
Dilated Bowel on US	88.8%	11.2%	0
Thick wall bowel on US	0	23%	77%
Decrease bowel peristalsis	0	80.9%	19.1%
Free fluid	0	12%	88%
Decrease bowel peristalsis and Thick wall bowel on US	0	55.56%	44.44%
Decrease bowel peristalsis and Free fluid	0	94.4%	5.6%
Unstable vital sign	100%	0	0
Patients without one of US variables and signs and symptoms of acute abdomen	0	0	100%

DISCUSSION

59.3% of patients who had one of characteristics of small bowel obstruction in X-ray, had SBO (Table 2), thus X-ray was not a diagnostic test therefore is necessary to use other diagnostic tests. But patients who had one of US variables for diagnosis of small bowel obstruction, 100% had SBO. Therefore US was better than X-ray. (Table 1).

Dilated bowel: Dilated bowel defined as (>25 mm) diameter for small bowel. Considering that dilated bowel had the most specificity (100%) among the other US variables for patients with SBO and had high sensitivity (97.7%) so if patients had sign and symptoms of SBO and had dilated bowel on US, 88.8% needed to emergent surgery consult. (Table 2, 3, figure 1)

Decrease bowel peristalsis: Decrease bowel peristalsis defined as back and forth movements of spot echoes inside the fluid-filled bowel. Decrease bowel peristalsis had the most sensitivity among the other US variables for diagnosis of SBO. Decrease bowel peristalsis had (100%) sensitivity for small bowel obstruction and (67.4%) specificity for this patients because decrease bowel peristalsis was often presented in all cause of acute abdomen (not only in SBO) So patients who had decrease bowel peristalsis had a cause of acute abdomen such as

SBO, appendicitis, large intestine obstruction, ascites, incarcerated hernia, cholecystitis or peptic ulcer perforation therefore decrease bowel peristalsis in spite of high sensitivity for small bowel obstruction, it had 67.4% specificity for these patients. So if patients had signs and symptoms of SBO and decreased bowel peristalsis on US, 80.9% needed to undergo urgent surgery consult. (Table 2,3, figure 1)

Thick wall: Thick wall bowel (more than 4mm) on US had only 40.9% sensitivity for diagnosis of SBO, so if patients had signs and symptoms of SBO and thick wall bowel on US, 23% needed to undergo urgent surgery consult. (Table 2,3, figure 1). But if thick wall bowel had presented with decreased bowel peristalsis, 55.56% needed to undergo urgent surgery consult. (Table 3)

Fluid filled: Free fluid had only 4.5% sensitivity and 88.4% specificity for diagnosis of SBO, but if free fluid had presented with decreased bowel peristalsis, sensitivity was 95.4% (table 2, figure 2). So if patients had signs and symptoms of SBO and free fluid on US, 12% needed to undergo urgent surgery consult. (Table 2, 3, figure 1). But if free fluid had presented with decreased bowel peristalsis, 94.4% needed to undergo urgent surgery consult. (Table 2)

This research as compared to the other recent researches about the role of bedside ultrasonography in diagnosis of small bowel obstruction in the emergency department which had the same sample size. The results of this research are similar to the other researches. Sensitivity of ultrasonography was 91% for the study of Timothy B Jang, 97% for Taylor, 97.7% for Unluer and 100% for this research. Dilated bowel (>25mm) was the most sensitive specification among the other ultrasonography variables for Timothy B Jang and Unluer (sensitivity 91% for Timothy B Jang, 94% for Unluer) for this research dilated bowel had 97.7% sensitivity and (100%) specificity for SBO. Decreased bowel peristalsis had (100%) sensitivity for small bowel obstruction and (67.4%) specificity for these patients because decreased bowel peristalsis was often presented in all causes of acute abdomen (not only in SBO). Therefore dilated bowel was the most important in US variables for diagnosis of SBO. (figures 3)(14, 23, 24). Results of the researches about the role of US for diagnosis of SBO which were done by radiologists and emergency physicians were the same as each other. (14, 25)

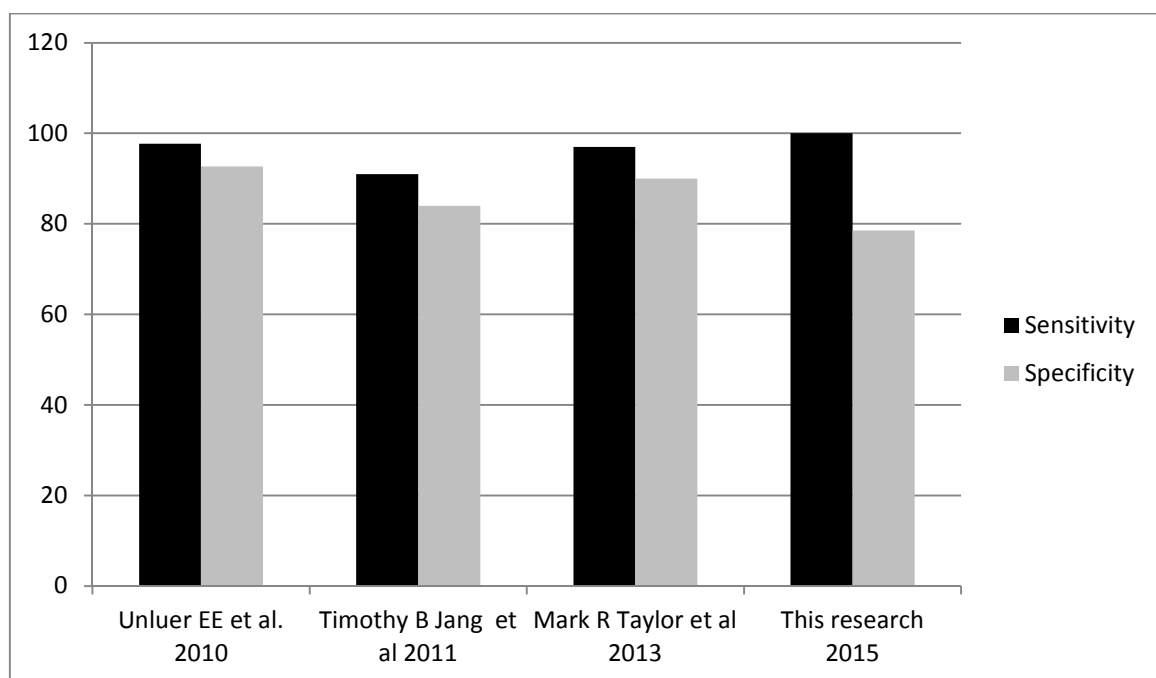


Figure 3: Sensitivity and Specificity of (US) for (SBO) Diagnosis in recent researches

The latest disposition method in references of Emergency Medicine is as follows:

1- Disposition methods for SBO in Rosen's Emergency Medicine 2014: "All patients with SBO merit admission to the hospital. One recent study found that patients with SBO admitted to a surgical service for inpatient management had a shorter length of stay, lower hospital charges, and lower mortality than those admitted to the medical service. This was attributed largely to the fact that those patients in whom conservative management was failing and who needed surgical intervention were identified more quickly when being managed primarily by the surgical team. However, in the community setting, where hospitalists with internal medicine and family practice training have assumed a large role in the management of surgical patients, it may not be logistically possible to admit patients with SBO directly to a surgical service."⁵

2- Disposition methods for SBO in Tintinalli's Emergency Medicine 2016:" Admit patients with bowel obstruction to the hospital. Surgical consultation should generally be obtained in the ED or at the time of admission. A dynamic ileus should also be admitted for the treatment of the underlying cause and until resolution of the ileus."6

In this research, we performed Point of care abdominal ultrasound with characteristics of US variables (decrease bowel peristalsis, thick wall bowel, dilated bowel, free fluid) to determine a new disposition method for the patients with SBO. Abdominal US is used in epigastr and periumbelical area.

Point of care abdominal ultrasound can also address three questions (figure 4): (1) Are there signs of dilated bowel? (2) Are there signs of decrease bowel peristalsis? (3) Are there signs of free fluid or thick wall bowel?

Point of care abdominal ultrasound for disposition patients with small bowel obstruction is as follows: When SBO is suspected and patient have abdominal pain, nausea, or vomiting, abdominal distention and constipation and hasn't any other cause of acute abdomen such as tenderness, rebound tenderness, morphi's sign, mesenteric ischemia or perforated abdominal halo viscose in plain abdominal X-ray and in US haven't abdominal aortic aneurism, cholecystitis, ovarian cyst rupture, ovarian torsion, hemorrhagic ovarian cyst, extra uterine pregnancy(EP), point of care abdominal ultrasound for disposition patients with small bowel obstruction is as follows: patients with dilated bowel (>25 mm) or unstable vital signs need to emergent surgery consult. Second, if they don't have dilated bowel, assess for presentation of decrease bowel peristalsis or thick wall bowel or free fluid: A - If they have decrease bowel peristalsis or thick wall bowel or free fluid and stable vital signs, need to urgent surgery consult. B -If they haven't decrease bowel peristalsis or thick wall bowel or free fluid, should be admitted in observation unit for non surgical treatment.

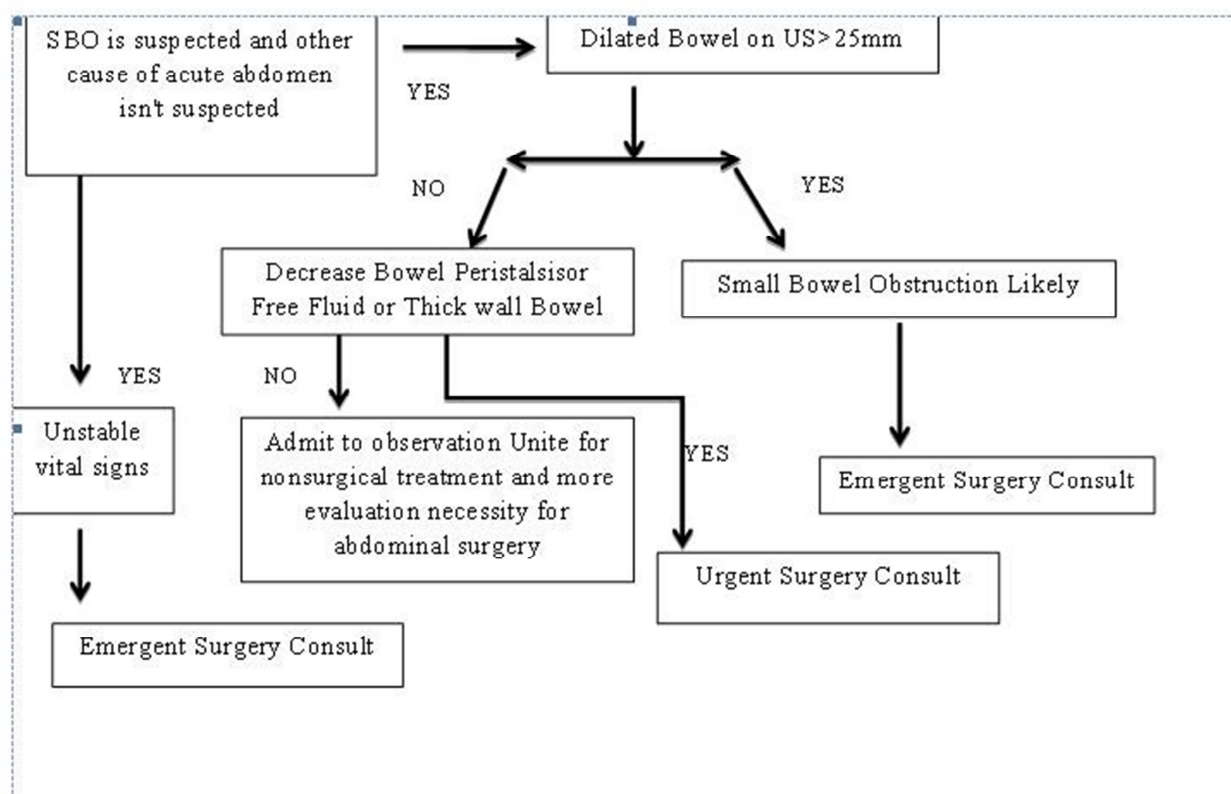


Figure4: point of care of ultrasound for small bowel obstruction

Key message:

What is already known on this subject?

The latest disposition method in references of Emergency Medicine is as follows:

All patients with SBO merit admission to the hospital and surgical consultation should generally be obtained in the ED or at the time of admission.

What this study adds?

A New Point of Care abdominal Ultrasound can help physicians to dispose SBO patients and time determination of surgery as follows:

A- Surgical consultation should emergently be obtained in the ED for patients with dilated bowel (>25 mm) or unstable vital signs.

B-Surgical consultation should urgently at the time of admission for who have decrease bowel peristalsis or thick wall bowel or free fluid with stable vital signs.

C-Patients who had signs and symptoms of SBO but haven't one of US variables (dilated bowel, decrease bowel peristalsis or thick wall bowel or free fluid), should be admitted in observation unit for non surgical treatment.

Limitations

Patients with DKA (diabetic ketoacidosis), nasogastric tube, abdominal paracentesis and ascitis can disorder the results of US for SBO so we couldn't participate them in this study.

Conclusion: Sensitivity and Specificity of US was better than Sensitivity and Specificity of X-ray. A New Point of Care abdominal Ultrasound can help physicians to dispose SBO patients and time determination of surgery as follows:

A- Surgical consultation should emergently be obtained in the ED for patients with dilated bowel (>25 mm) or unstable vital signs.

B- Surgical consultation should urgently at the time of admission for who have decrease bowel peristalsis or thick wall bowel or free fluid with stable vital signs.

C- Patients who had signs and symptoms of SBO but haven't one of US variables (dilated bowel, decrease bowel peristalsis or thick wall bowel or free fluid) , should be admitted in observation unit for non-surgical treatment.

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Authors' Contributions

All authors contributed equally in planning and carrying out this project.

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