

# The Best Strategy for Nasogastric Tube Removal in Patients with Acute Appendicitis Complicated with Ileus: A Case Report and Review.

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## Case report

**Keywords:** Appendicitis, complicated appendicitis, laparoscopic appendectomy, peritonitis, ileus, nasogastric tube, Urografin study, enhanced recovery after surgery (ERAS)

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# Abstract

## Background

Acute appendicitis is one of the most common causes of the acute abdomen. However, acute appendicitis complicated with ileus is uncommon. By presenting this case, we aim to give some suggestions on the postoperative care, especially an algorithm for the insertion and removal of nasogastric tube.

## Case presentation

A 20-year-old man presenting with left lower abdominal pain and symptoms of ileus was diagnosed with acute appendicitis complicated with ileus by computed tomography scan. A nasogastric tube was inserted for the ileus preoperatively. He underwent laparoscopic appendectomy, during which periappendiceal abscess with local peritonitis was noted. The nasogastric tube was removed on the first postoperative day, but symptoms of ileus developed again. Urografin study revealed contrast media retaining in the small bowel, so nasogastric tube reinsertion was performed. The nasogastric tube was removed on the ninth postoperative day after the recovery from ileus. The patient was discharged on the thirteenth postoperative day.

## Conclusion

Patients of acute appendicitis with ileus should be assessed carefully. Nasogastric tubes shouldn't be removed until the following requirements are satisfied: Firstly, symptoms of abdominal distention and nausea relieve. Secondly, no more hypoactive bowel sounds are found. And finally, nasogastric tube drainage becomes less than 200mL per day, or the passage of flatus or stool presents.

## Background

Acute appendicitis is one of the most common causes of the acute abdomen, with incidence about 233 in 100,000 population per year [1]. The clinical presentations, laboratory studies and the imaging pictures vary widely, making early diagnosis of patients with atypical presentation difficult.

Acute appendicitis complicated with bowel obstruction is uncommon. The ileus could be classified into four types by its pathophysiology: mechanical obstruction, paralytic ileus, ischemia or strangulation [2]. Paralytic ileus, which is mainly caused by a ruptured appendicitis, and subsequent peritonitis, is the most common type among the four [2].

By this case presentation, we not only want to make a brief review of the diagnosis and management of acute appendicitis complicated with ileus, but also review the definition, pathophysiology and the management of postoperative ileus, and further propose an algorithm for the insertion and removal of nasogastric (NG) tubes.

## Case Presentation

A 20-year-old man without underlying disease presented to our emergency room (ER) because of progressive intermittent abdominal pain at the left lower quadrant (LLQ) for hours. Accompanied symptoms included abdominal distension and decreased frequency of defecation. No other symptoms, such as nausea, vomiting or fever were reported. Physical examination disclosed LLQ tenderness without other specific signs, such as peritoneal signs, psoas sign, obturator sign, Rovsing's sign, or McBurney's point tenderness. Laboratory data reported leukocytosis with neutrophil predominance (white blood cell count:  $14.25 \times 10^9/L$ , segmented neutrophil percentage: 82%). Abdominal radiography showed prominent bowel gas with some fecal materials. Abdominal and pelvic computed tomography (CT) scan on that day revealed no significant intra-abdominal lesions. Bowel stimulation with oral Metoclopramide and Bisacodyl suppository were prescribed, and the patient was discharged on the same day.

The patient's symptoms persisted after he was discharged. Moreover, progression of abdominal distention and diarrhea for six times developed on the next day. The patient visited our ER again three days later. At the triage, the body temperature was  $38.1^\circ\text{C}$ . Physical examination revealed similar tenderness at the left lower abdomen, with extension to the middle abdomen. There were no peritoneal signs, psoas sign, obturator sign, Rovsing's sign, or McBurney's point tenderness. Laboratory data showed similar leukocytosis with neutrophil predominance (white blood cell count:  $14.65 \times 10^9/L$ , segmented neutrophil percentage: 87%). Abdominal ultrasonography revealed enteropathy with suspected extra-enteric abscess formation at the lower abdomen, and fluid retention in the colon and small bowel. Standing abdominal radiography showed no free air, but prominent bowel gas with diffuse bowel dilatation, suggestive of ileus (Fig. 1a). Besides, abdominal and pelvic CT scan disclosed enhancing appendiceal wall with an intra-luminal fecalith, and diffuse dilatation of the small bowel on the same day (Fig. 1b). Under the impression of acute appendicitis complicated with ileus was impressed, a decompressive NG tube was inserted, and empirical intravenous Ceftriaxone was prescribed. General surgeon was consulted on the same day of his re-visit, and emergent laparoscopic appendectomy was conducted.

During the surgery, inflamed and erosive appendix with turbid ascites, periappendiceal abscess and periappendiceal adhesion was noted. The appendix was transected with auto-suture (Endo GIA; Medtronic, Minneapolis, MN, United States). A 7 mm combination waste vent (CWV) drainage tube was placed in the Douglas pouch at the end of the operation.

After the operation, the patient was admitted to general ward. The antibiotics was adjusted to empirical Flomoxef. On the first postoperative day (POD1), the NG tube showed minimal drainage amount, so the patient tried oral intake with water oral water ingestion, resulting in no nausea or vomiting. The NG nasogastric tube was removed on POD1. The flatus passed on POD2, and the stool passed on POD3.

On POD2, the patient complained about abdominal distention with intermittent dull pain, which persisted despite usage of intravenous Morphine. Physical examination revealed decreased frequency of bowel

movement, so prokinetics including Bisacodyl suppository and intravenous Metoclopramide were prescribed.

Abdominal radiography was taken for persistent abdominal distention on POD4, disclosing even more prominent gas in the bowel loops in comparison to the preoperative period (Fig. 2a). On the same day, Urografin study was performed to evaluate the cause of the ileus, showing retention of contrast medium in the small bowel 24 hours after Urografin intake (Fig. 2b).

The patient suffered from severe abdominal colic pain on the next day after Urografin study (POD5), and there had been no stool or flatus passage since POD3 despite all the efforts of bowel stimulants. Physical examination showed a hard and distended abdomen, with the percussion revealing hyper-tympanic sounds and hypoactive bowel sounds. Episodic vomiting with bile-like content for about 250 mL took place on POD6. For suspected postoperative ileus, oral intake was hindered, the treatment of Bisacodyl suppository and intravenous Metoclopramide was continued, and a decompressive NG tube was inserted on POD6. A large amount of bile-like content for about 1400 mL was drained in the first 8 hours after the insertion of the NG tube. The following abdominal radiography on POD7 revealed persistent bowel loops distention, with some contrast medium entered into the ascending colon (Fig. 2c).

On POD7, two days after the NG tube insertion, the amount of the NG tube drainage decreased gradually from 350 mL to 150 mL in every 8 hours (Fig. 3), and the abdominal distension improved. Flatus passage with defecation was also noted. The patient resumed liquid diet since POD8. The NG tube was clamped on the third day (POD8), and removed after the abdominal radiography showing residual focal bowel loops distention with the passage of Urografin to the rectum on the fourth day after insertion (POD9) (Fig. 4). The CWV drain was removed due to minimal drainage amount, and Flomoxef was replaced by oral Cefixime on POD13. The patient was discharged on POD13.

## Discussions

Acute appendicitis is a usual cause of acute abdomen, and the clinical pictures vary from patient to patient. Patients with suspicious appendicitis are preliminarily evaluated by the Alvarado score to assess the risk of appendicitis [3]. The score is composed of history, results of physical examination and laboratory data [3]. The patient with a higher Alvarado score possesses a higher likelihood of appendicitis. Further imaging studies are indicated in patients with Alvarado score greater than 4, and have at least intermediate probability of acute appendicitis [4, 5].

In this presented case, he had no specific symptoms and signs except for leukocytosis at first, with the Alvarado score 3. The CT scan also disclosed negative results. However, more symptoms developed after he was discharged from the ER. At the time of his revisiting ER, the Alvarado score reached 4, and repeated CT scan revealed appendicitis with ileus. Though some reports suggested that leukocytosis as well as elevated C-reactive protein achieve satisfactory sensitivity in setting up the diagnosis, neither of the two test results can confirm or rule out acute appendicitis [6]. Back to our patient, there was no supportive evidence to start the treatment for acute appendicitis at the first visit. However, it might be

reasonable to keep the patient observed in the ER. If his condition deteriorated or the calculated Alvarado score increased gradually, repeated CT scan was reasonable to achieve a definite diagnosis.

The classification of acute appendicitis is important as the treatment strategies may differ [4]. Traditionally, surgeons divide acute appendicitis into two groups: simple or complicated. For the former, which is defined as an inflamed appendix without signs of gangrene, perforation, intra-peritoneal purulent fluid, contained phlegmon or intra-peritoneal abscess, appendectomy remains a golden standard of the treatment [4]. Despite the fact that some opposing clinicians propose the potential benefits of non-operative initial management for simple appendicitis, there is still no satisfactory quality evidence to support sole antibiotics treatment for appendicitis [7, 8]. As to the treatment of complicated appendicitis, firm conclusions fail to be drawn [4]. Some studies claim that operation is associated with more complications, and that non-operative treatment is a better option [9, 10], while others advocate aggressive operation, assuming that non-operation treatment leads to higher recurrent rate [11].

Acute appendicitis complicated with small bowel obstruction is uncommon, which could be classified into four types: mechanical obstruction, paralytic ileus, ischemia and strangulation [2]. The adhesion from the peri-appendicular inflammation is the culprit of mechanical obstruction. Paralytic ileus is the result of perforated appendicitis, which leads to generalized or localized peritonitis. The thromboembolic event happening in the ileal artery and its branches following the appendicitis leads to the ischemic type [12]. Moreover, the inflamed appendix wrapped around a long loop of small bowel creates a closed loop obstruction which is strangulated [13]. Early surgical intervention is important in patients of appendicitis with bowel obstruction. Whichever features of intestinal obstruction predominate, midline vertical incision was suggested, for the reason that the exact pathological type is nearly impossible to be determined beforehand. McBurney's incision may be enough if the obstruction is paralytic or mechanical. However, it would be dangerous to incise at the McBurney's point when strangulation or mesenteric ischemia presents, as these pathological changes are likely to be overlooked through a small and lateral approach [2]. There were no convincing studies comparing the outcome of open surgery and laparoscopic approach, but a case report proposed that laparoscopic surgery should be performed if the etiology of bowel obstruction other than appendicitis was suspected [14].

Postoperative ileus (POI) is a frequent complication after abdominal surgery; however, the definition and the diagnosis of the disease underlie wide variation. Some reports define it as no passage of flatus or stool and tolerance of an oral diet on the postoperative day 3 (POD3). They also name the patient with "prolonged" POI if two or more of the following five conditions presented since POD4: nausea or vomiting; inability to tolerate an oral diet for more than 24 h; absence of flatus for more than 24 h; abdominal distension, and radiologic confirmation [15]. However, different experts characterize it by different duration and clinical parameters [16, 17]. Furthermore, there is no consensus on the necessary diagnostic tools. Some experts preferred plain films, while others order CT scan or water-soluble contrast studies such as Urografin study, or even the combination of various tests [18, 19].

Urografin study is widely reported to play both diagnostic and therapeutic parts in adhesive small bowel obstruction [20]. The study acts as similar roles in patients with POI. By Urografin study, surgeons are able to differentiate paralytic ileus with mechanical intestinal obstruction, and to distinguish those who need emergent surgery [21]. Moreover, the high osmolality of the water-soluble contrast medium is theoretically believed to reduce bowel wall edema, which further increase the luminal diameter and subsequently relieve the symptoms of POI [22]. Nevertheless, the study only shows benefits in patients with lower gastrointestinal symptoms [22]. Besides, in terms of the timing of the study, it was suggested to be done once surgeons assess the patients and suspect prolonged POI clinically since POD4 by some convincing clinical trials [22, 23].

Venara et.al. divide the pathophysiology of POI into three phases. The first one is neurological phase, which is involved by the activation of sympathetic tone, and the subsequently activated CycloOxygenase-2 (COX 2). The second phase is described as inflammatory phase. The phase was predominated by the inflammatory process, which may be disseminated from a localized inflammatory site, such as appendix, to surrounding peritoneal cavity. The increase of bowel wall permeability in this phase may induce bacterial translocation. Last but not least, the third phase, called vagal phase, is the recovery phase, which is caused by the elevation of vagal tone, the effects of acetylcholine and

serotonin, and its anti-inflammatory effects [24]. Once the inflammation resolves, the swelling of the bowel walls will relieve, and the bowel motility will recover gradually.

In this case, the localized peritonitis not merely caused paralytic ileus preoperatively, but also acts as risk factor for POI [25], which can be attributed to the second phase of pathophysiology. Besides, the more complicated the appendicitis is, the larger extent of the peritoneum tends to be damaged during the surgery, and the damaged peritoneum will further enhance the inflammation [25]. While we were managing our patient, the probability of the POI should be kept in mind, and took actions earlier once the symptoms presented.

Most of the treatments and preventions of POI are well-established. Non-medical management, such as fluid optimization and chewing gum [26], as well as medications, such as prokinetics and nonsteroidal anti-inflammatory drugs (NSAIDs) are the examples [18]. However, there has been no consensus about the timing of insertion and removal of the NG tube. Lots of the experts insert NG tubes when the patients have abdominal distension or tenderness and vomiting over 500 ml, and some remove the NG tube when the patients feel hungry subjectively [18].

The trend of postoperative care followed the concept of “Enhanced Recovery After Surgery (ERAS)” nowadays, advocating to remove the inserted tubes, including NG tubes, as well as commence oral feeding as soon as possible, and to reserve the use of opioids for pain control [27]. The concept was initially adopted in elective surgeries; however, it was also confirmed to decrease the complications and fasten the recovery of bowel motility after emergent abdominal surgeries in recent studies [28]. Early removal of NG tubes after the elective surgeries tends to decrease the risk of complications, accelerate the return to oral feeding, and significantly reduce patients’ discomfort [29]. Furthermore, in patients who

underwent surgeries for small bowel obstruction, early removal of NG tubes was also proven to lower the risk of POI, and cause no severe complications [30].

In this case, the NG tube was removed on POD1 because of the minimal drainage amount. However, the patient suffered from abdominal distention and vomiting since POD2, and confirmed POI diagnosis by abdominal radiography and Urografin study on POD7. The conditions improved after the reinsertion of the NG tube. After the experience of managing such a case, we suggested that the NG tube should be left in situ after the surgery until decompression amount decreased to less than 200 mL per day or the presence of flatus or stool passage [32], and the NG tube should be reinserted immediately once the patient vomits. Intravenous Morphine should be limited, or better replaced by NSAIDs. Furthermore, Urografin study should be held until NG tube was inserted and recorded a fair amount. Thus, the passage of contrast medium can both achieve the therapeutic effect and the adequate diagnostic value. The suggested algorithm of insertion or removal of NG tubes is shown in Fig. 5 [31, 32].

## Conclusions

Early removal of NG tubes and to commence oral feeding soon after operation becomes a trend of postoperative care nowadays. However, it is not routinely suitable for patients with ileus. We suggests that patients of acute appendicitis or other minor diseases complicated with ileus should be assessed carefully. NG tubes shouldn't be removed until the following requirements are satisfied: Firstly, symptoms of abdominal distention and nausea relieve. Secondly, no more hypoactive bowel sounds are found. And finally, NG tube drainage becomes less than 200 mL per day, or the passage of flatus or stool presents.

## Abbreviations

**ER**

Emergency room

**CT**

Computed tomography

**NG tube**

Nasogastric tube

**CWV drain**

combination waste vent drain

**POD**

Postoperative day

**POI**

Postoperative ileus

**ERAS**

Enhanced Recovery After Surgery

**NSAIDs**

Nonsteroidal anti-inflammatory drugs

# Declarations

## Ethics approval and consent to participate

Since this is a case report, the ethics approval from institution review board (IRB) and the consent to participate are not required in our hospital.

## Consent for publication

Consent to publish the case was obtained from our patient.

## Availability of data and materials

Not applicable

## Competing interests

The authors declare that they have no competing interests.

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## Authors' contributions

YJ Tseng and PY Huang contributed to this paper equally.

PY Huang and TH Lin took charge of the emergency surgery. PY Huang and TH Lin took care of the patient in the ward. YJ Tseng and PY Huang were responsible for writing the manuscript and edited the figures; PC Lee, TH Lin and RH Hu revised the paper.

All authors have read and approved the manuscript.

All authors have agreed both to be personally accountable for the author's own contributions and to ensure that questions related to the accuracy or integrity of any part of the work, even ones in which the author was not personally involved, are appropriately investigated, resolved, and the resolution documented in the literature.

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## Additional information

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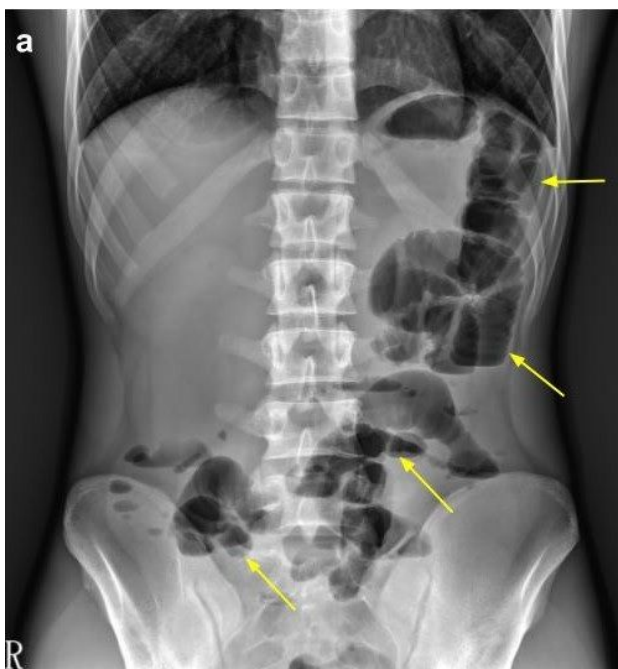
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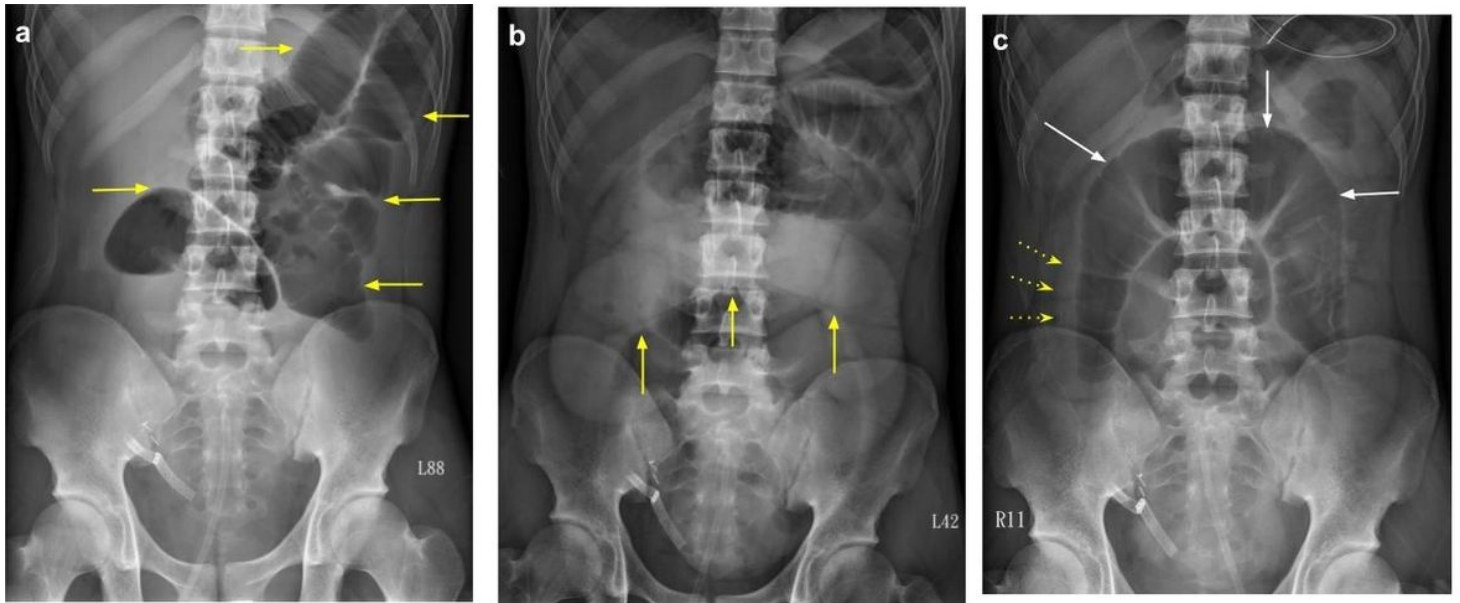
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## Figures



**Figure 1**

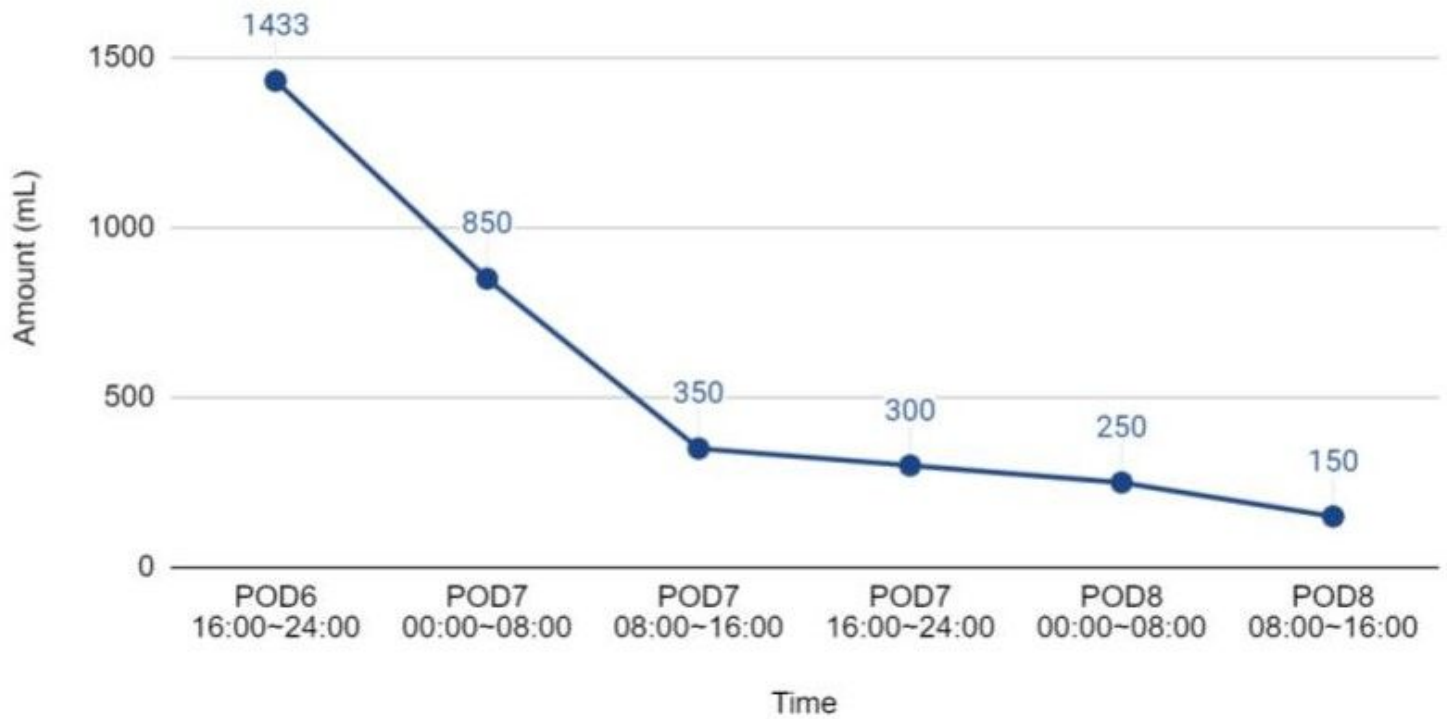
(a) Standing abdominal X-ray film on the second visit to ER showed prominent bowel gas with diffuse bowel dilatation (arrows). (b) Abdominal and pelvic CT scan on the second visit to ER showed enhancing appendiceal wall with an intra-luminal fecalith (circled by the line).



**Figure 2**

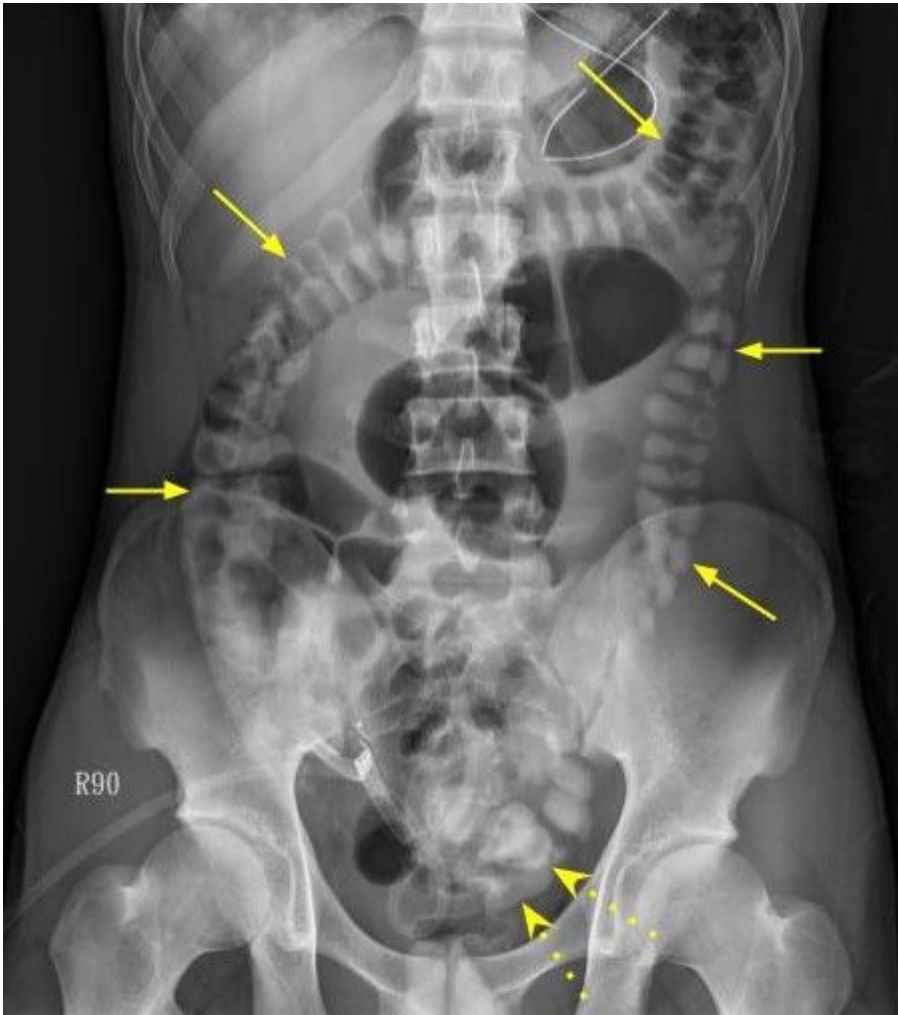
(a) Abdominal radiography on POD4 showed more prominent gas in the bowel loops (parallel arrows), compared with Fig.1a. (b) Urografin study on POD4 to POD5 showed contrast retention in the small bowel (upward arrows) 24hr after the intake of the contrast medium. (c) Abdominal radiography on POD7 showed similarly distended bowel loops (white arrows), with little contrast medium entered into the ascending colon (dotted-lined arrows).

## NG decompression amount



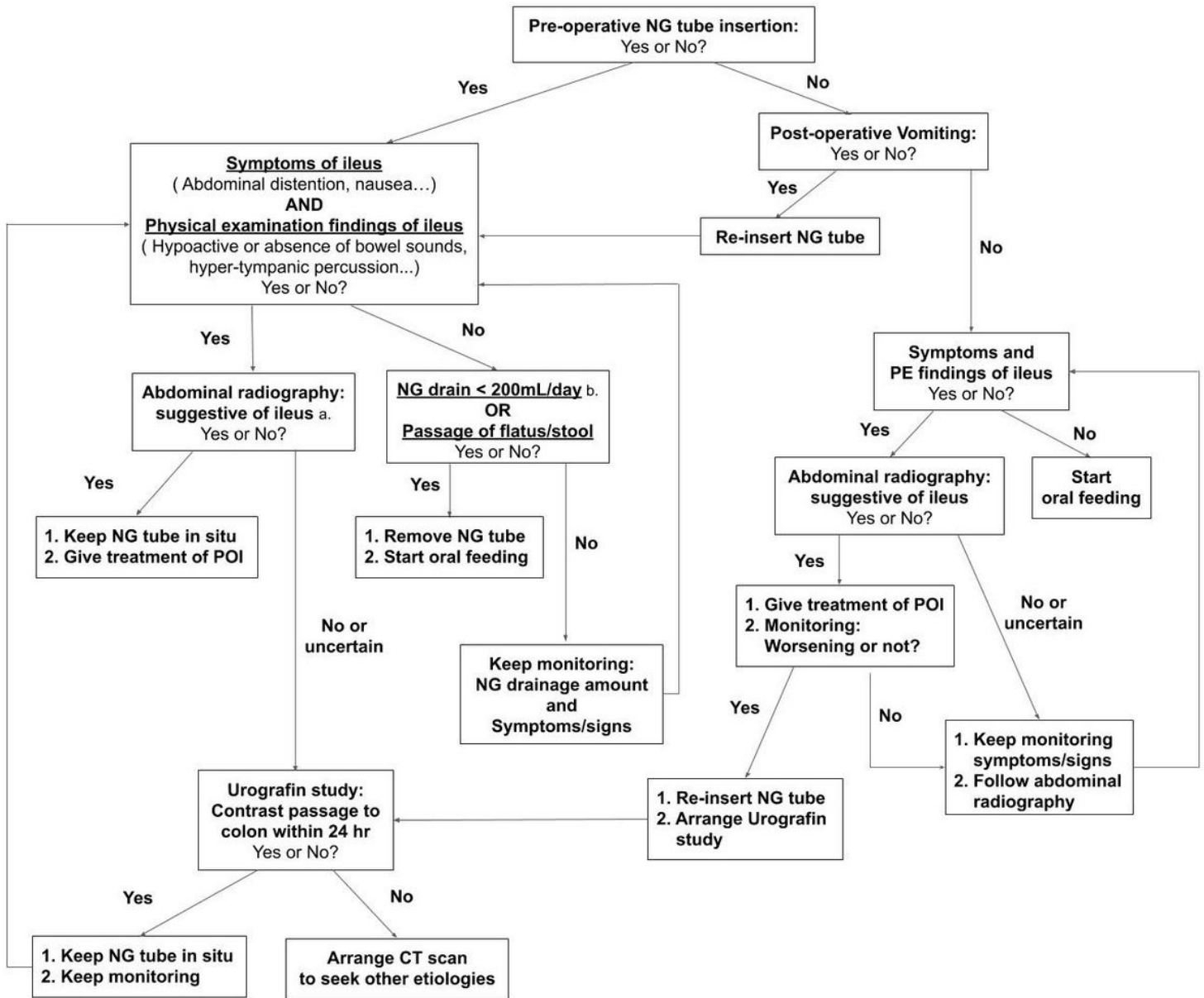
**Figure 3**

NG decompression amount since the re-insertion of NG tube: The decompression amount from the NG tube re-inserted since POD6. The NG tube was clamped on POD8, and removed on POD9.



**Figure 4**

Abdominal radiography done on POD9 showed residual focal bowel loops distention with the passage of contrast medium into the colon (arrows) and the rectum (dotted-lined arrows).



**Figure 5**

Postoperative NG insertion and removal in patients of appendicitis complicated with ileus: (a) Ileus pattern on abdominal radiography: Dilated loops of bowels, which are generalized or localized, with the diameters of small bowels exceeding 3cm, colon exceeding 6cm or cecum exceeding 9cm. (b) The rule of thumb from the surgeons of our hospital.