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INSPISSATED MECONIUM SYNDROME
—NEONATAL MECONIUM OBSTRUCTION IN THE ILEUM WITHOUT MUCOVISCIDOSIS—

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Abstract

We experienced of five newborns with obstruction of terminal ileum or ascending colon due to very tenacious black-green meconium in the absence of mucoviscidosis. These disorders differ from meconium plug syndrome, meconium ileus and paralytic ileus in the following criteria:

1) All the infants vomited bile-stained material.
2) They passed normal meconium just after birth, which was followed by tenacious black-green meconium.
3) The intestinal sounds were noticed over the abdomen.
4) The fluid levels were seen in the upright plain film.
5) The colon had normal peristalsis at Gastrografin® enema.
6) There was no recurrence after obstruction being released.

Therefore, we prefer to distinguish this disease from meconium plug syndrome, meconium ileus and paralytic ileus and call it "Inspissated Meconium Syndrome". We believe that this obstruction was caused by a large amount of PAS-positive mucus, secretion from the obstructed intestinal mucosa. In this paper, we describe on four clinical cases and one autopsy case of this particular type.

Intestinal obstruction in the neonate may result from a variety of causes. A few kinds of neonatal intestinal obstruction, such as meconium ileus and meconium plug syndrome are caused by abnormal meconium. Rarer forms of meconium obstruction, however, may be due to other conditions. In our hospital, 10,534 newborn infants have been examined during the past six years. There were twenty-one cases of neonatal intestinal obstruction due to causes other than paralytic ileus among them. The cases included seven anorectal malformations, three intestinal atresias, two omphaloceles, two meconium plug syndromes, one aganglionosis, one malrotation and five special

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types of intestinal obstruction. These special types consisted of obstruction of the terminal ileum or ascending colon by a pack of very tenacious black-green meconium which occurred in the absence of mucoviscidosis.

CASE REPORT

Case 1 : A 3-day old baby girl weighing 2,950 g at birth was transferred to our hospital with a complaint of bilious vomiting and abdominal distension. She had been passing small amounts of normal meconium since her birth. A distended abdomen, meteorism and hyperactive peristalsis were noted on admission. A plain erect film of the abdomen showed numerous gas shadows and multiple fluid levels in the small intestine, but no gas shadows were seen in the large intestine (Fig. 1). A Gastrografin® enema study showed

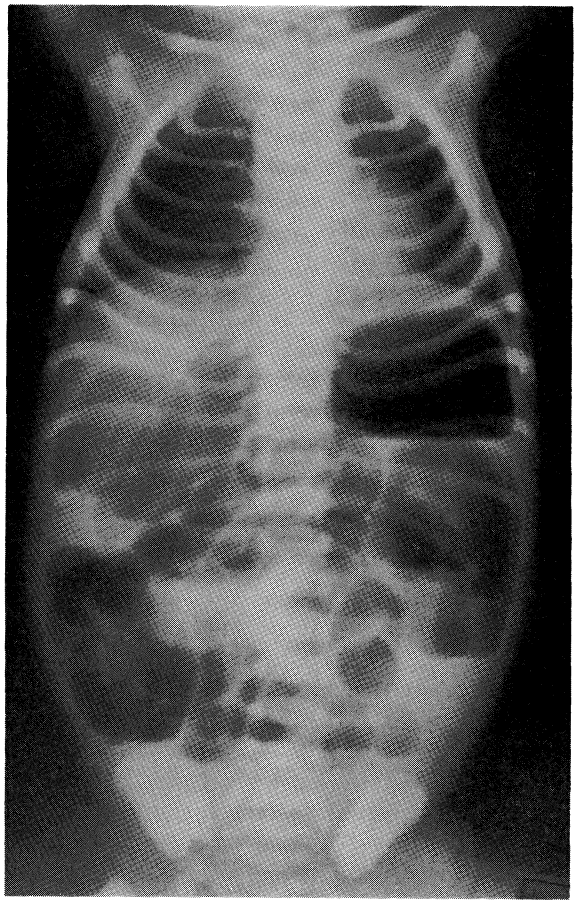

Fig. 1. Upright view of case 1. Dilatation of the small bowel with multiple fluid levels, but no gas shadows in the pelvis.

that the large intestine is normally positioned with no filling defect (Fig. 2), so we made a diagnosis of congenital ileal atresia. During infusion therapy, dark green tenacious meconium passed nine hours after enema. This was followed by a relief of the abdominal distension, and the bowel sounds became normal. She improved clinically. The glucose absorption curve, fat absorption test, serum protein, stool tryptic activity and the sweat chloride levels were all normal.

Case 2: A female infant weighing 3,250 g at birth had a history of abdominal distension and vomiting of bile-stained material from the second day after birth. She had been passing small amounts of normal meconium twice a day. A plain erect film of the abdomen showed the same findings as

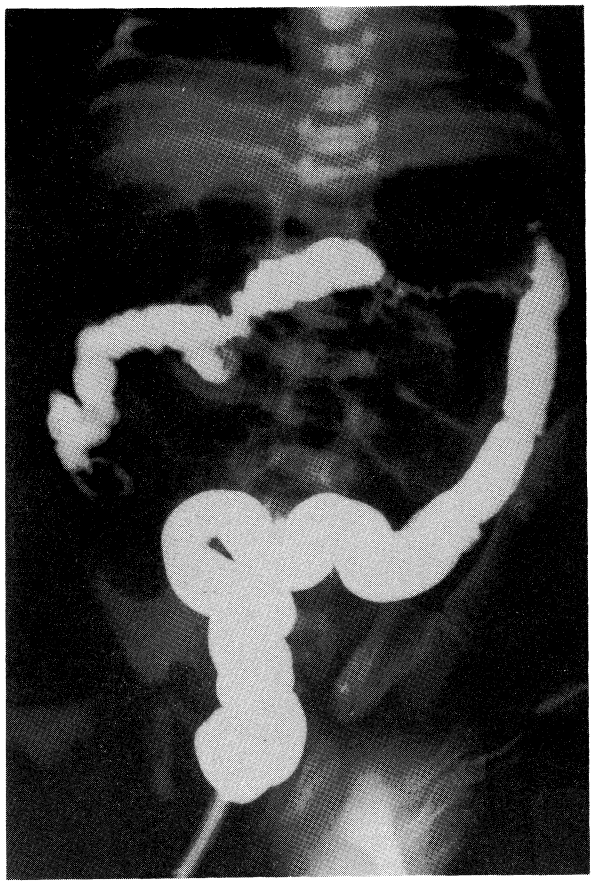

Fig. 2. Supine view of a Gastrografin enema of case 1.
Normal position of the large bowel and no filling defect.
The terminal ileum does not fill with Gastrografin.

case 1 at 6 days of age (Fig. 3). A Gastrografin® enema study demonstrated that the large intestine is normally positioned without filling defect. The terminal ileum was not visualized at first (Fig. 4A), but found filled with the contrast medium on pressure (Fig. 4B). Subsequently she passed large amounts of meconium and the symptoms subsided.

Case 3: A female infant weighing 3,410 g at birth had a history of abdominal distension and bile-stained vomiting from fourteen hours after birth. She had passed normal meconium by enema at thirty-six hours after birth, but abdominal distension and vomiting continued. A Gastrografin® enema study at 3 days of age showed normal colon, small terminal ileum for 20 cm on the oral side of the ileocecal valve and then dilated ileum. We diagnosed this as a congenital ileal stenosis or duplication. At operation, we

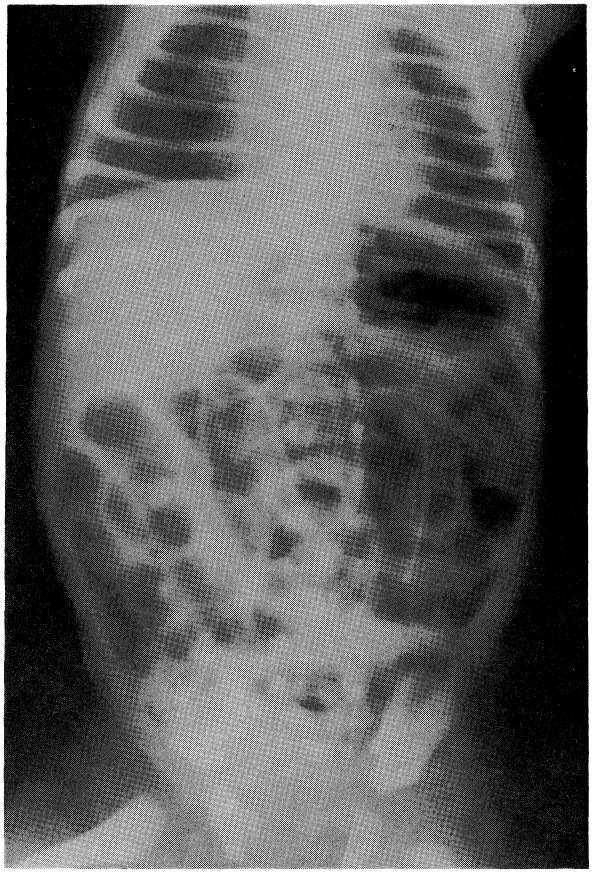

Fig. 3. Upright view of case 2. Dilatation of the small bowel with multiple fluid levels, but no gas shadows in the pelvis.

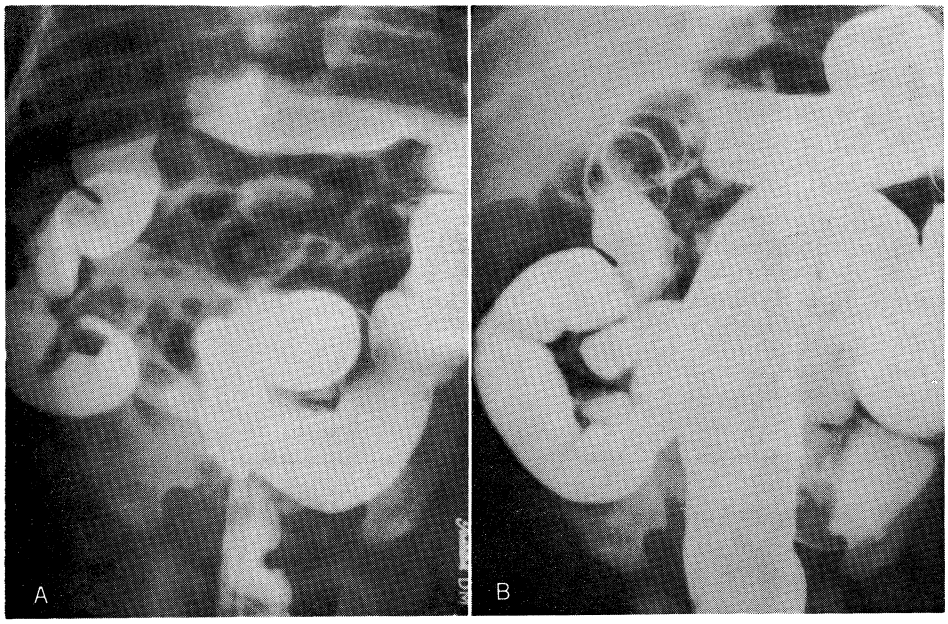

Fig. 4. Supine view of a Gastrografin enema of case 2.
Normal position of the large bowel and no filling defect (A). On pressure (B), the terminal ileum fills with the contrast medium.

found only slight change in caliber of the terminal ileum, but no organic stenosis. We think that her ileus was due to very tenacious meconium stuck in the terminal ileum, because she passed a large amount of very tenacious black-green meconium after operation and abdominal distension and vomiting subsided.

Case 4: A male premature infant weighing 1,880 g at birth had general edema with a history of abdominal distension started from 6 hours after birth. Vomiting of bile-stained material developed at 84 hours of age. Small amounts of normal meconium passed spontaneously at 53 hours after birth. A plain erect film of the abdomen showed gas filled loops of small intestine with multiple fluid levels. A Gastrografin® enema study showed granulated filling defects in the cecum and ascending colon (Fig. 5). After the enema, she passed large amounts of very tenacious black-green meconium and the signs and symptoms of ileus subsided, but she died of uremia.

Case 5: A male premature infant weighing 1,165 g developed general cyanosis and died of respiratory distress about 5 hours after birth. By autopsy, the cause of death was ascribed to atelectasis and subarachnoid hemor-

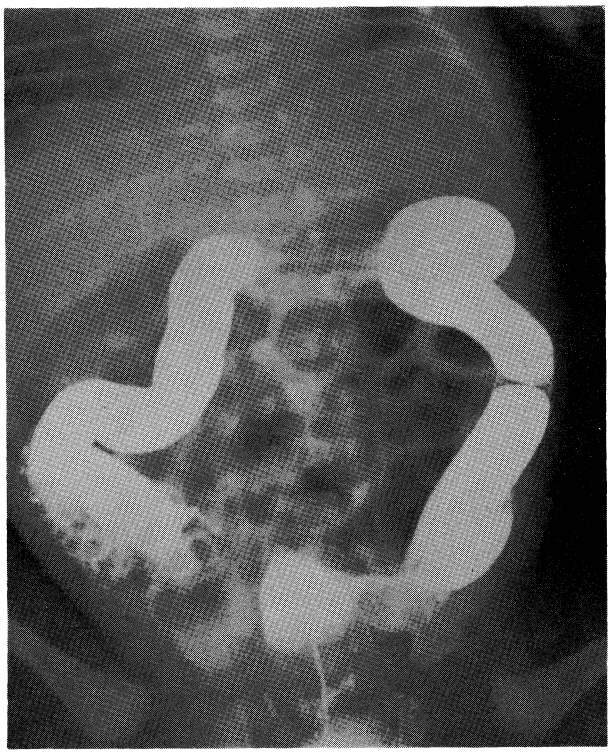

Fig. 5. Supine view of a Gastrografin enema of case 4.
Granulated filling defects in the cecum and ascending colon.

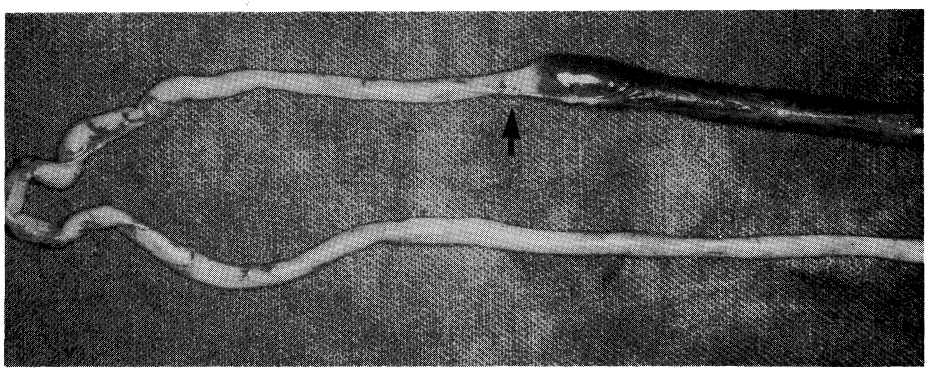

Fig. 6. Some caliber change in the ileum 42 cm from the ileocecal valve was found at autopsy.

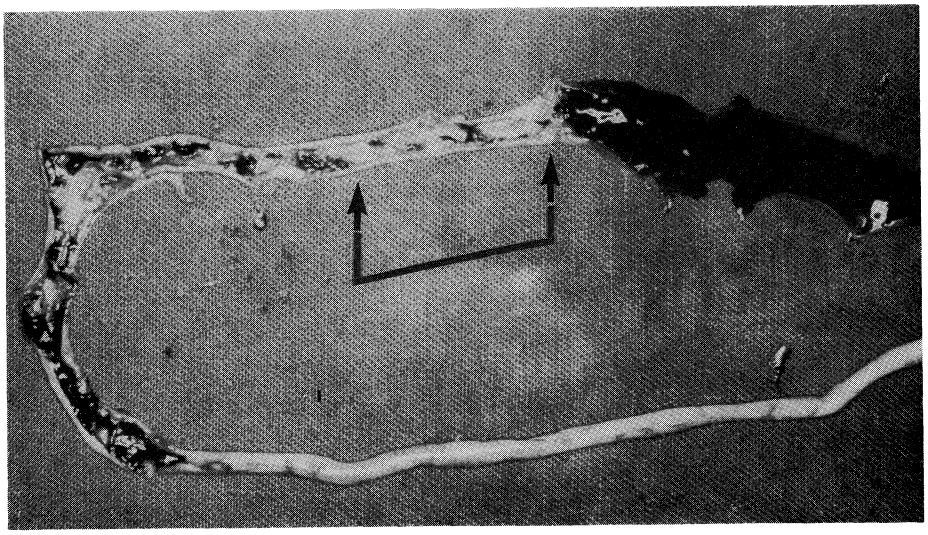

Fig. 7. The very tenacious meconium is stuck firmly to the mucosa over a distance of 2 cm. The mucosa is separated from the submucosal layer.

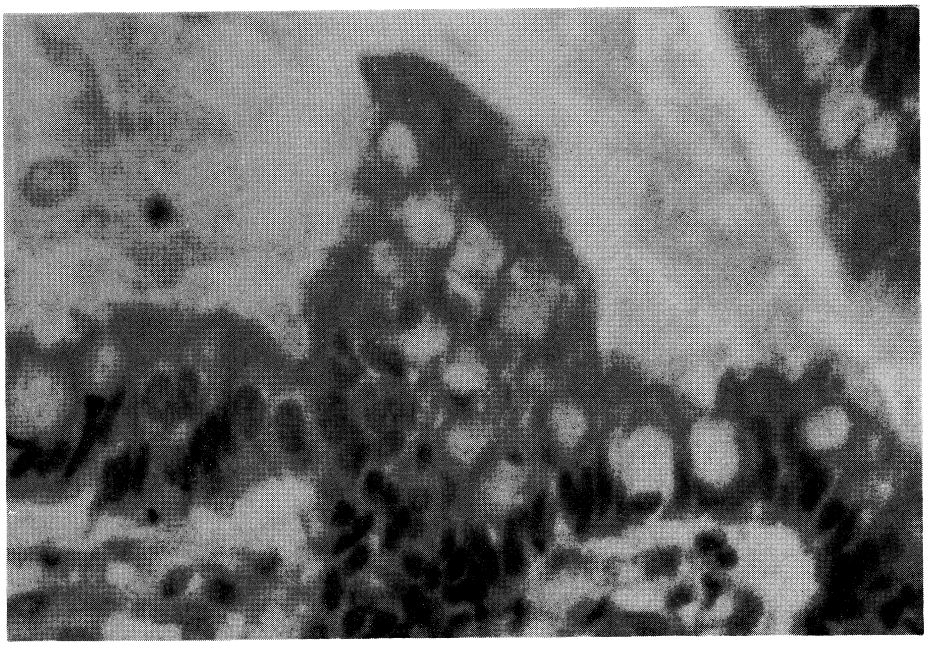

Fig. 8. Microphotograph of the affected ileum demonstrates the secretion of mucus from goblet cells in the mucosa (×850, H & E stain)

rhage. A moderate change in the caliber of the ileum was present 42 cm from the ileocecal valve. The diameter of the ileum was 6 mm on the oral and 3 mm on the anal side of this change. The large intestine was of normal caliber (Fig. 6). A large amount of normal meconium was found in the jejunum and large intestine. Somewhat tenacious meconium was found in the ileum close to the oral side of the narrowed segment. In the narrowed segment itself, very tenacious dark green meconium was stuck firmly to the mucosa over a distance of 2 cm. This mucosa and the tenacious meconium were separated from the submucosal layer (Fig. 7). The water contents of this meconium in the narrowed segment was lower than that in any other segments.

Histologically, the tenacious meconium covered by exfoliated mucosa contained a large amount of PAS-positive and Alcian blue-negative mucus. Fig. 8 shows the hypersecretion of mucus from goblet cells in the mucosa. Hypertrophy of lymph nodules and heavy lymphocytic infiltration were found in the submucosa of obstructed segment of ileum (Fig. 9). Normal ganglion cells were present and the histologic appearance of pancreas was normal.

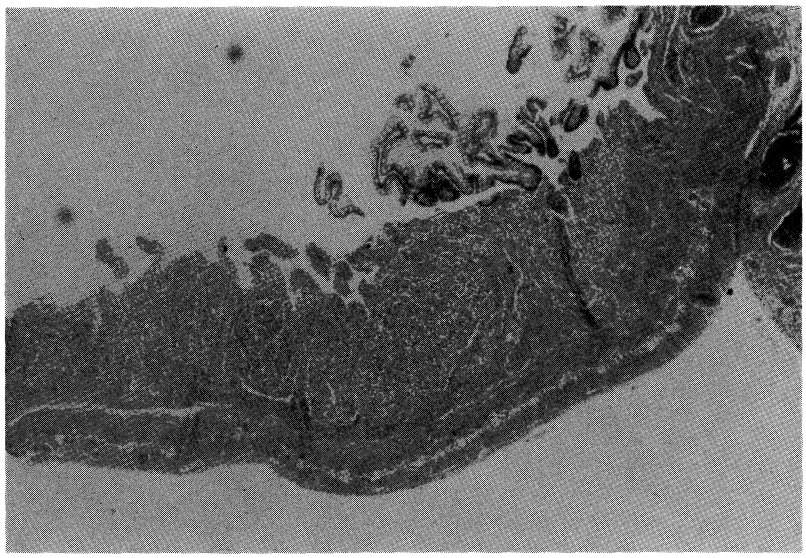

Fig. 9. Microphotograph of the affected ileum demonstrates hypertrophy of lymph nodules and heavy lymphocytic infiltration of the submucosa (×50, H & E stain).

DISCUSSION

Various types of intestinal obstruction seen in neonates differ markedly from those seen in adults (Table 1). Meconium is the cause of some of the diseases. It took a long time before it was realized that neonatal meconium obstruction can occur in the absence of mucoviscidosis. Meconium obstruction caused by mucoviscidosis is called meconium ileus, which accompanies obstruction of the terminal ileum. A firm mass of meconium which has a pale unpigmented elastic conic cap in the rectum, is termed a meconium plug. Berti[1] reported, in 1898, a case of intestinal obstruction caused by such a meconium plug in the rectum. Clatworthy[2] called it meconium plug syndrome.

TABLE 1. Causes of Intestinal Obstruction in the Newborn

- I. Mechanical
  - A. Congenital
    - 1. Intrinsic
      - a. Atresia and stenosis
      - b. Meconium ileus
      - c. Meconium plug syndrome
      - d. Inspissated meconium syndrome
      - e. Hypertrophic pyloric stenosis
      - f. Imperforate anus
    - 2. Extrinsic
      - a. Malrotation with or without midgut volvulus
      - b. Volvulus without malrotation
      - c. Congenital peritoneal band
      - d. Incarcerated hernia
      - e. Duplication of stomach or bowel
      - f. Preduodenal portal vein and other anomalous vascular courses
  - B. Acquired
    - 1. Intussusception
    - 2. Peritoneal adhesion
- II. Functional
  - A. Aganglionosis
  - B. Pseudoileus neonatorum
  - C. Secondary paralytic ileus

Undoubtedly, meconium ileus and the meconium plug syndrome are not the only conditions causing meconium obstruction in the newborn. Kornblith[3] and Hurwitt[4] have reported other cases of meconium ileus, which were due not to cystic fibrosis of the pancreas, but to stenosis of the pancreatic duct. Rickham and Boeckman[5] reported seven cases with meconium obstruction in the absence of mucoviscidosis in 1965. In three of the cases, infant passed small normal meconium immediately after birth, but developed intestinal

obstruction at some time in the following seven days. Radiography of the abdomen showed loops of distended small intestine and fluid levels, but no gas shadow in the pelvis in all cases. By operation, it was revealed that four of the seven cases had obstruction with sticky inspissated meconium in the jejunum or terminal ileum, two cases had obstruction with sticky yellowish

Table 2. Case reports of "Inspissated Meconium Syndrome"

Author	Year	Number of Patient	Diagnosis & Treatment	Site of Obstruction	Obstructing Agent
Burger	1938	1	Laparotomy	Terminal ileum	Meconium mass
Hinden	1950	1	Laparotomy	Terminal ileum	Hard putty-like meconium
Emery	1957	3	Autopsy	Small intestine	Firm tenacious, normally pigmented meconium
Zachary	1957	1	Enema	Terminal ileum or proximal colon	Plugs of meconium
Rickham	1965	3	Laparotomy	Terminal ileum	Sticky inspissated meconium
		1	Laparotomy	Distal jejunum	A plug of inspissated intestinal contents
Maclaurin	1965	1	Laparotomy	Terminal ileum	Sticky green meconium
Fuku	1969	1	Laparotomy	Terminal ileum	Inspissated meconium
Bughaighis	1971	1	Laparotomy	Terminal ileum	Hard mass of meconium
Doulan	1974	1	Laparotomy	Ileum	Inspissated meconium
		1	Gastrografin enema	Ileum	Large amounts of lumpy meconium
Shigemoto	1976	2	Gastrografin enema	Terminal ileum	Tenacious inspissated black-green meconium
	1977	1	Autopsy	Ileum	Tenacious inspissated black-green meconium
	1978	1	Gastrografin enema & Laparotomy	Terminal ileum	Tenacious inspissated black meconium
		1	Gastrografin enema	Cecum ~ Ascending colon	Tenacious inspissated black-green meconium

white meconium in the terminal ileum and one case had obstruction with sticky greyish calcified material in the terminal ileum and colon. Rickham[6] called these conditions " meconium disease ", but considered that the etiology of the former four cases might differ from that of the latter three cases. Our five cases are similar to the former four of Rickham's cases. The first of these cases was reported by Burger[7] in 1938. His patient had an obstruction of terminal ileum with firm meconium.

In a series of approximately 800 autopsies on stillborn infants reported by Emery[8] (1957), three cases showed obstruction in the small intestine that appeared to be due to firm tenacious, normally pigmented meconium. The tryptic activity of the meconium was normal whereas the water content was extremely low. He considered that some alteration in the local water balance between the meconium and the affected segment of the bowel would explain the altered physical properties of the meconium to some extent. A case reported by Zachary[9] developed temporary intestinal obstruction after passing normal meconium, but cured by passing firm meconium by enema. It seems to be of the same type with the intestinal obstruction described above. Emery called it " meconium plug elsewhere in the intestine ". The fifth case of ours resembles the autopsy case of Emery because the water content of the tenacious meconium causing the obstruction was low (65.9%, colon : 72.8%).

There are only one case each of Hinden[10] (1950), Maclaurin[11] (1965), Fuku[12] (1969) and Bughaighis[13] (1971) and two cases of Doulan[14] (1974), which are similar to our special type of neonatal intestinal obstruction due to abnormal meconium (Table 2).

We show the criteria of this disorder in Table 3. There is another disease, the functional ileus with no discoverable cause, that should be distinguished from this disorder. There are one case reported by Schaffer[15], seven cases by Sieber[16] and/or pseudoileus neonatorum by Yamanouchi[17]. The intestinal obstruction of our special type differs from this functional ileus in that

TABLE 3. Criteria of Inspissated Meconium Syndrome

1. All infants vomited bile-stained material.
2. They passed normal meconium just after birth, which was followed by tenacious black-green meconium.
3. The intestinal sounds were noticed over the abdomen.
4. The fluid levels were shown in the upright plain film.
5. The colon had normal peristalsis at Gastrografin enema.
6. There was no recurrence after obstruction being released.

obstruction is the result of accumulation of abnormal meconium and abdominal radiography shows fluid levels.

Therefore, we consider this disease different from the meconium plug syndrome, meconium ileus and paralytic ileus[18], and suggest the name "Inspissated Meconium Syndrome"[19]. We believe that obstruction might possibly be due to tenacious meconium secreted in the latter half of the fetal period by goblet cells in the parts of ileal mucosa because copious amounts of normal meconium were present in the large intestine. Hypertrophy of lymph nodules seems to be associated with the secretion of the mucus.

Once the tenacious meconium passes, no further obstruction occurs. Therefore, we consider that hypertonic Gastrografin® enema is the most effective method of treatment.

Acknowledgment

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