

Functional Intestinal Obstruction in the Neonate

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Howat, J. M., and Wilkinson, A. W. (1970). *Archives of Disease in Childhood*, 45, 800. **Functional intestinal obstruction in the neonate.** Fifty-one neonates with functional intestinal obstruction are described. The commonest causes of functional obstruction were sticky meconium, sepsis, respiratory distress, and the prolonged infusion of fluid through a PVC catheter in the umbilical vein. Functional obstruction was diagnosed on routine investigation in 34 patients and in the remainder Hirschsprung's disease was the most commonly suspected cause of organic obstruction.

Intestinal obstruction is one of the commonest conditions responsible for the admission of an infant to a surgical paediatric unit in the first 4 weeks of life, only spina bifida and congenital heart disease being more common. An anatomical abnormality which causes an organic obstruction sooner or later gives rise to the 3 classical signs of repeated vomiting, abdominal distension, and failure to pass normal meconium or stool. This combination of signs may also occur in the absence of an organic lesion because of a disturbance of intestinal peristalsis or when meconium is abnormally viscid, and such a disturbance has been called 'functional intestinal obstruction'. Hirschsprung's disease and meconium ileus have been excluded from this category because they have an organic basis.

Dunn (1963) found 24 intestinal obstructions in 4,754 babies delivered in hospital, and in 12 of these the obstruction was functional as defined above. In the 11 years from 1 January 1959 to 31 December 1969, 256 neonates with acute intestinal obstruction (excluding oesophageal atresia and anorectal anomalies) were referred to the Professorial Surgical Unit at The Hospital for Sick Children, Great Ormond Street. 51 (20%) of these babies suffered from functional obstruction, and 52 others (37 with Hirschsprung's disease and 15 with meconium ileus) had similar clinical features on admission but their obstruction did not resolve spontaneously. This report is concerned with the clinical features and management of the babies with functional intestinal obstruction.

Clinical Features

Almost half the babies were admitted within the first 3 days of life, 35 (68.6%) within the first week, and only

6 (12%) were aged more than 2 weeks (Table I). Birthweights and maturity are shown in Tables II and III; 7 babies were premature and 8 were full term but of low birthweight. Pregnancy had been uncomplicated in 40 cases, and the complications in the remaining 11

TABLE I
Age and Sex Distribution of Babies in Series

Age	Sex		Total
	Male	Female	
0-3 days ..	13	12	25
4-7 days ..	7	3	10
7-14 days ..	7	3	10
2-4 weeks ..	3	3	6
Total	30	21	51

TABLE II
Maturity of Babies in Series

Maturity	No. of Cases
Premature (< 36 weeks)	7
Full term (36-40 weeks)	37
Postmature (> 40 weeks)	1
Not recorded	6

TABLE III
Birthweight of Babies in Series

Birthweight (kg.)	No. of Babies
< 2.5	13
> 2.5	31
Not recorded	7

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TABLE IV
Complications of Pregnancy

Diagnosis	No. of Cases
Pre-eclamptic toxæmia	3
Antepartum hæmorrhage	3
Disproportion	1
Threatened abortion	1
Fetal distress	1
Maternal diabetes	1
Maternal epilepsy	1

are shown in Table IV. 2 of the mothers with pre-eclamptic toxæmia had been heavily sedated before delivery, and an epileptic mother was taking a high dose of anticonvulsants. There was no history of hydramnios in any of the 51 cases. Respiratory distress had occurred after birth in 6 babies of whom 1 was premature and 5 had been delivered by caesarean section, in 2 cases for pre-eclamptic toxæmia, in 2 for antepartum hæmorrhage, and in 1 for fetal distress.

Though all patients were referred with a diagnosis of intestinal obstruction, in 23 only one of the diagnostic signs of repeated vomiting, abdominal distension, and a failure to pass normal meconium or stool was present; 21 only vomited (bile-stained fluid in 11 and feeds in 10), and 2 had only a distended abdomen. 2 or more signs were observed in 28 infants; in 10 there was vomiting and abdominal distension, in 2 vomiting and delay in passing meconium, in 6 distension and delay in passing meconium or constipation. In the remaining 10 all 3 signs were present.

A meconium plug or sticky meconium was passed after rectal examination by 15 babies of whom 3 were premature, 5 had respiratory distress after birth, and the mothers of 3 had been heavily sedated before delivery. The vomiting and abdominal distension then subsided and the babies made normal progress. None of these babies was subsequently found to have Hirschsprung's disease or mucoviscidosis and none developed necrotizing enterocolitis.

Some form of infection was found in 11 babies, of whom 5 had bronchopneumonia, 3 had gastro-enteritis, 1 a septic umbilicus, 1 pustules in the axilla, and 1 septicaemia following exchange transfusion. All were assumed to be septicaemic, and after blood had been taken for culture were treated with antibiotics. The features of obstruction resolved in 9, but *Esch. coli* septicaemia, which was confirmed by blood culture in 3 babies, proved fatal in one with enteritis and one with bronchopneumonia (Case 1).

Case 1. This boy (birthweight 2530 g.; gestation: 36 weeks) was admitted on the 7th day of life, having progressed normally until the previous day when he had started to vomit bile, and later yellow offensive material. The abdomen was soft with several small firm loops of bowel palpable, and there was minimal air entry over both lung fields. Chest x-ray showed bilateral bronchopneumonia, but as there were loops of small bowel with

fluid levels and an absence of gas in the colon in an erect abdominal x-ray, laparotomy was undertaken. The findings were suggestive of meconium ileus and a Bishop-Koop ileostomy was made. He died a few hours later. At necropsy there was bronchopneumonia and marked adrenal softening, but no evidence of organic obstruction or fibrocystic disease. His blood culture and a swab taken from the lungs at necropsy grew *Esch. coli*.

In 5 babies a wide bore PVC cannula had been inserted into the umbilical vein before admission through which 10% dextrose had been infused over periods of 2 to 4 days to correct hypoglycaemia. The obstruction resolved spontaneously in all these 5 babies soon after removal of the cannula.

In 1 patient who had repeated convulsions and respiratory difficulties and died on the third day of life, the features of obstruction were attributed to severe intracranial damage. At necropsy he was found to have extensive intracranial hæmorrhage.

One hypothyroid baby (Case 2) caused sufficient diagnostic difficulty to merit description.

Case 2. This girl (birthweight 3400 g.; gestation: full term) was referred from the paediatric department of another hospital at the age of 3 weeks with vomiting, abdominal distension, and failure to pass a stool for 5 days. On admission the distension was confirmed and on rectal examination there was normal stool in the rectum. Erect x-ray of the abdomen showed a normal gas pattern and Hirschsprung's disease was excluded by barium enema. She remained constipated and slightly distended, but as her vomiting had settled and she was gaining weight on breast-feeding, she was discharged at the age of 6 weeks. She was readmitted when 3 months old with persistent constipation and failure to gain weight. When complementary feeding was introduced she was observed to feed sluggishly and her appearance was now highly suggestive of hypothyroidism, a diagnosis confirmed by a serum PBI of 0.9 µg./100 ml. and serum cholesterol of 444 mg./100 ml. Her constipation was resolved on treatment with thyroxine.

Factors responsible for the obstruction were identified in 34 babies, in several of whom more than one factor was present (Table V). 7 of these 34 infants were investigated for Hirschsprung's disease, 4 by barium

TABLE V
Factors Responsible for Functional Obstruction in 34 Babies

Cause of Obstruction	No. of Cases
Meconium plug or sticky meconium ..	15
Sepsis	11
Respiratory distress syndrome	6
Umbilical vein cannula	5
Maternal drugs	3
Cerebral hæmorrhage	1
Hypothyroidism	1
Total	42

enema, 2 by anorectal pressure studies, and 1 by rectal biopsy.

In the remaining 17 patients no aetiological factor was detected. 7 had been vomiting feeds, but as they fed normally after admission and no abnormality was found on clinical examination, they were discharged without further investigation. In 4 babies with bile-stained vomit, incomplete small bowel obstruction was excluded by *x*-ray examination after a barium meal which was followed through. Further investigation was also necessary in 6 babies suspected of having Hirschsprung's disease, a diagnosis excluded in 2 by barium enema and in another by rectal biopsy. In Case 3 ano-rectal pressure studies and in Cases 4 and 5 barium enema examination at first appeared to confirm the clinical diagnosis of Hirschsprung's disease but in all 3 this was later shown to be incorrect.

Case 3. This girl (birthweight 1600 g.; gestation: 34 weeks) vomited on the 12th day of life and by the following day the abdomen had become distended and she had not passed a stool for 24 hours. A small stool was passed on the 14th day, but vomiting and distension persisted. When first seen by a surgeon at the referring hospital on the 15th day of life the abdomen was distended. The rectum was empty and withdrawal of the examining finger was followed by a gush of air and fluid faeces. She was transferred on the following day. Ano-rectal pressure studies were said to be typical of Hirschsprung's disease. At laparotomy the colon and upper rectum were dilated, the lower rectum was contracted, and a transverse colostomy was established. Subsequent barium studies of the distal colon appeared to confirm the diagnosis of Hirschsprung's disease but on review the appearances were regarded as equivocal. Recurrent respiratory infections delayed rectal biopsy until the age of 7 months, when a full thickness trans anal rectal biopsy was found to be ganglionic and her colostomy was closed. Her recovery thereafter was uneventful.

Case 4. This boy (birthweight 2800 g.; gestation: full term) was admitted on the 3rd day of life with abdominal distension and vomiting. A tiny meconium plug had been passed on the 2nd day but there had been no subsequent bowel action. Loops of bowel were visible through the abdominal wall and there was only blood-stained mucus in the rectum. Erect *x*-ray of the abdomen showed gas throughout the small bowel but none in the colon, the barium enema demonstrated a 'cone' at the splenic flexure. The findings at laparotomy however, were not typical of Hirschsprung's disease and as several biopsies were ganglionic the abdomen was closed. After operation he was reluctant to feed and had no bowel action for 5 days. He was given pancreatin by mouth with improvement in feeding and satisfactory bowel function, and thereafter made an uninterrupted recovery. A sweat test showed that he did not suffer from fibrocystic disease.

Case 5. This boy (birthweight 2500 g.; gestation: full term) was admitted on the 2nd day of life having

vomited bile-stained fluid. He had passed meconium. The abdomen was distended and tympanitic and the rectum was empty. Erect *x*-ray of the abdomen showed gaseous distension to the level of the sigmoid colon, but no fluid levels, and barium enema was suggestive of Hirschsprung's disease with a 'cone' at the splenic flexure. At laparotomy on the day of admission the large bowel was distended to the splenic flexure and empty and contracted beyond. A stab enterotomy at the splenic flexure produced viscid meconium, and as a biopsy taken from the rectosigmoid was ganglionic the abdomen was closed. He was given pancreatin by mouth and his obstruction resolved. He was readmitted at the age of 2 months for repair of an incisional hernia, but while awaiting operation he vomited, suddenly collapsed, and died. At necropsy he was found to have a strangulated volvulus of the small intestine round an adhesion from the previous laparotomy, but there was no evidence of fibrocystic disease.

Management and Results

Oral feeding was started within 24 hours of admission in 36 babies, and in 37 a stool had been passed within the same period; in only 1 baby were feeding and a normal bowel action delayed beyond the 3rd day. Intravenous fluids were administered to 10 babies; 6 were given 5% dextrose, 3 had 4.3%

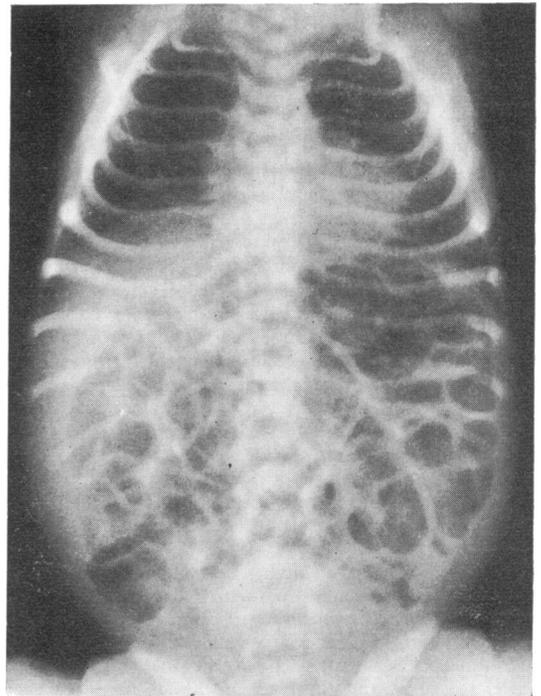


FIG.—Erect *x*-ray of abdomen showing gaseous distension of whole intestine without fluid levels.

dextrose in 0.18% saline, and 1 with bronchopneumonia and septicaemia required blood transfusion. X-ray examination of the abdomen in the supine and erect position was carried out on all babies and in 34 showed the typical picture of functional obstruction, with gaseous distension of the whole intestine but no fluid levels in dilated loops of intestine of different sizes (Fig.) The features of obstruction resolved spontaneously in 45 babies. In 4 others the abdomen was opened, with a preoperative diagnosis of Hirschsprung's disease in 3, and meconium ileus in 1. 4 babies died, 1 with extensive cerebral damage, 1 with gastro-enteritis and septicaemia, 1 with bronchopneumonia and septicaemia a few hours after laparotomy, and 1 with volvulus of the small intestine 2 months after the original operation.

Discussion

Abdominal distension is common in newborn babies, 6% of whom fail to pass meconium on the first day of life (Sherry and Kramer, 1955), but when these features persist into the second day and repeated vomiting begins the existence of intestinal obstruction must be assumed. In the majority of these babies it is usually possible on the basis of the clinical features and a plain x-ray of the abdomen in the erect position to determine whether the obstruction is functional, but the exclusion of an organic obstruction, especially if it is due to Hirschsprung's disease, may require further investigation.

The history of the pregnancy, how the mother was treated during it, and what happened to the baby during and after delivery, are all important in the differentiation of functional from organic obstruction. Ganglion blocking agents given to the mother during pregnancy or labour may produce a transient ileus in the newborn baby (Morris, 1953; Hallum and Hatchuel, 1954). Raffensperger, Johnson, and Greengard (1961) have described ileus in a baby born to a heroin addict, and Dunn (1963) reported 2 babies with functional obstruction whose mothers had been heavily sedated before delivery. The mothers of 3 babies in this series had been heavily sedated during labour. Maternal hydramnios is often associated with organic obstruction above the level of the ileum (DeYoung, 1958; Scott and Wilson, 1957; Lloyd and Clatworthy, 1958; Jeffcoate and Scott, 1959), but its absence is not of much diagnostic help though there was no history of maternal hydramnios in any case in this series.

Of the 12 patients with functional intestinal obstruction described by Dunn (1963), 9 suffered

from respiratory distress, all were born after less than 37 weeks' gestation, and 5 had been delivered by caesarean section. Respiratory distress had occurred in only 6 babies in this series, of whom 5 were delivered by caesarean section but only 1 was premature. This discrepancy in the incidence of respiratory distress between Dunn's and our series may be partly explained by the much better information available to Dunn about the immediate postnatal period than that which we could obtain, but perhaps also reflects the successful expectant treatment of most of these babies in neonatal nurseries. The fact that 4 of 6 babies in our series with respiratory distress required a barium enema to exclude Hirschsprung's disease suggests that in the majority of these babies reaching a neonatal surgical unit the diagnosis cannot be made without special investigation.

Ueda, Okamoto, and Seki (1968) state that meconium obstruction is readily recognized and overcome by rectal examination or enema, but Cases 4 and 5 in our series may be examples of the unrelenting type of meconium obstruction described by Clatworthy, Howard, and Lloyd (1956). Babies with Hirschsprung's disease may also pass meconium after rectal examination and may be mistakenly diagnosed as suffering from meconium obstruction on clinical grounds; fatal enterocolitis has been described by Rickham (1969) as a consequence of this error, but it is not a complication of meconium obstruction.

Sepsis, either alimentary or generalized, is one of the commonest causes of functional intestinal obstruction in the neonate (Ueda *et al.*, 1968). Though neonates with serious infection may have no focal signs, a careful search for a primary septic focus is essential if abdominal exploration, which carries a high mortality in the presence of septicaemia, is to be avoided in infants with transient obstruction due to sepsis. Superficial infections, such as skin pustules or a septic umbilicus, are easily recognized, but infections in the respiratory and alimentary tracts, which are less readily detected on clinical examination, are probably the portal of entry in the majority of cases of septicaemia (Ellis and Mitchell, 1968). Sepsis was a common cause of functional obstruction in this series, though bacteriological confirmation of suspected septicaemia was obtained in only 3 of 11 babies in whom a septic focus was detected; 8 of the infections were respiratory or alimentary.

Cannulation of the umbilical vein for even a short time may be associated with complications. Abdominal distension was observed by Farquhar and Smith (1958) in 3 babies after exchange

transfusion. Perforation of the colon after this procedure has been reported by Corkery *et al.* (1968) and by Orme and Eades (1968), who also described this complication in a baby given dextrose by umbilical vein catheter for 7 days. Toxic substances which can be leached out of PVC tubing by infused solutions have been shown by Duke and Vane (1968) to affect the normal response of the perfused human umbilical artery to stimuli, and by Bowery and Lewis (1968) to cause contraction of the isolated guinea-pig ileum; the effect on the portal vasculature of these substances and of a 10% solution of dextrose, which has a pH of 5.6 or less and is irritant, might explain the transient obstruction of 5 infants in this series.

In the first few days after birth hypothyroidism may not be detected on initial clinical examination, as the characteristic facial features are not necessarily present in early infancy, and the baby presents with features of obstruction which closely resemble Hirschsprung's disease (Ueda *et al.*, 1968). However, the exclusion of Hirschsprung's disease and observation of the infant's activity and feeding should raise the suspicion of hypothyroidism as a possible diagnosis before 3 months.

Straight x-ray of the abdomen in the supine and erect positions is the most useful routine diagnostic aid in neonatal intestinal obstruction, and the typical picture of functional obstruction has already been described. When Hirschsprung's disease is suspected screening of the abdomen after a barium enema by a paediatric radiologist is a reliable diagnostic procedure in 90% of cases (J. G. Lillie, 1970, personal communication), though it was wrongly diagnosed in 2 of the 8 babies in this series who had a barium enema. The diagnosis of Hirschsprung's disease may also be made with some confidence on anorectal pressure studies when a typical abnormal response is obtained and can be excluded in babies with a normal anorectal response, but premature babies with functional ileus cannot initially be separated from those with Hirschsprung's disease (Howard, 1969). Hirschsprung's disease was mistakenly diagnosed in one of 3 babies in this series investigated by anorectal pressure studies, who,

though born prematurely, was 2 weeks old at the time of the study.

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