

Resection and Primary Anastomosis of the Jejunum and Ileum in the Newborn*

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OBSTRUCTIVE LESIONS OF the jejunum or ileum in the newborn period have been a challenging problem to the surgeon, and have carried a high morbidity and mortality. The surgeon who encounters an intestinal lesion requiring resection can either exteriorize the intestine or perform a primary anastomosis. Exteriorization procedures commit the patient to an increased hospitalization and a second operation which is not without some added hazard. Primary anastomosis has been advocated in the past few years by various authors.^{1, 2, 6, 7} In this paper we are reporting our experience with resection and primary anastomosis of the jejunum and ileum in 14 newborn patients during a six year period.

ANATOMICAL AND PHYSIOLOGICAL CONSIDERATIONS

It has been stated⁵ that an infant's intestine is about 305 cm. long, and an infant cannot part with more than 38 cm. and live. Measurements in our pathologic material⁸ reveal there is considerable variation of the bowel length. The average in the full term newborn has been found to be as follows: duodenum, 5 cm.; jejunum and ileum, 248 cm.; colon and rectum, 45 cm. In the premature, there is a correspondingly lessened length. The average for a three pound 11 ounce premature was: duodenum, 3 cm.; jejunum and ileum, 230 cm.; colon and rectum, 37.5 cm. These measurements are of

real significance to the surgeon when confronted with an extensive resection, as the length of intestinal segment removed will ultimately effect both morbidity and mortality.

Kremen *et al.*,⁴ in a paper before this association in 1954, reported that the proximal 50 to 70 per cent of the small intestine of dogs can be removed with no apparent ill effects, as weight is maintained, protein and fat absorption are not significantly altered, but sacrifice of the distal 50 per cent of the small intestine produces a profound interference with fat absorption associated with loss of weight.

One of the ideas projected for the failure of the primary anastomosis in jejunal or ileal atresia has been the question of a possible absence of the myenteric plexus in the bulbous proximal segment or the small distal segment. Microscopic studies of these intestinal segments reveal the plexus to be present in a normal pattern in our material.

TECHNICAL CONSIDERATIONS

Primary anastomosis presents certain technical problems in the newborn, whose solution determines the success or failure of the procedure. From our previous experiences, we have come to believe that our present surgical approach should be as follows: First, decompression of the obstructed proximal segment by suction of all fluid and gas. Second, resection of the blind, bulbous, hypertrophied proximal segment in atresias, and the non-viable intestine in other obstructions. Third, the distal segment should be

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RESECTION AND ANASTOMOSIS OF JEJUNUM AND ILEUM

TABLE I.

Case	Sex	Age	Birth-weight	Lesion	Procedure	Result
1. G. S.	M	5 days	4-11	Atresia—ileum-perforation, pe-tonitis and large Meckel's diverticulum	Resection 42 cm ileum and Meckel's Diverticulum—end to side ileocolostomy.	Recovered
2. H. O.	M	6 days	3-11	Persistent omphalomesenteric duct with torsion and gangrenous ileum	Resection 15 cm ileum and omphalomesenteric duct—side to side anastomosis.	Recovered
3. A. L.	F	4 weeks	8-	Patent omphalomesenteric duct with partial prolapse of ileum	Resection 12 cm ileum and omphalomesenteric duct and umbilicus—end to end anastomosis ileum.	Recovered
4. B. C.	M	2 days	5-8	Multiple atresia and stenosis—jejunum with rudimentary mesentery and fetal peritonitis	Resection 89 cm jejunum—side to side anastomosis.	Recovered
5. G. L.	F	2 days	4-11	Atresia—jejunum perforated with local peritonitis	Resection 26 cm jejunum—end to side anastomosis.	Recovered
6. J. M.	M	3 days	6-11	Atresia—jejunum with volvulus perforation and local peritonitis	Resection 25 cm jejunum—end to side anastomosis.	Recovered
7. G. R.	F	1 day	7-14½	Atresia—ileum	Resection 19.5 cm ileum—side to side anastomosis.	Recovered
8. D. L.	F	3 days	5-11	Atresia—ileum	Resection 36 cm ileum—end to side ileocolostomy.	Recovered
9. M. C.	F	2 days	6-13	Atresia—ileum	Resection 19 cm ileum—side to side anastomosis.	Recovered
10. D. L.	F	2 days	7-5	Atresia—ileum, no terminal ileum or appendix and colon attached to umbilicus	Resection 18 cm ileum and 3 cm ascending colon—end ro side ileocolostomy.	Recovered
11. B. D.	M	1 day	7-7	Atresia—ileum	Resection 19 cm ileum—and to side ileocolostomy.	Expired.
12. B. M.	M	4 days	5-2	Malrotation, volvulus, perforation of ileum with fetal peritonitis	Resection 41 cm ileum and jejunum—only 18 cm small bowel remaining jejunocolostomy.	Expired.
13. G. G.	F	1 day	8	Multiple atresias ileum	Resection 75 cm ileum—side to side anastomosis.	Expired.
14. B. H.	M	2 days	5-	Malrotation, volvulus small intestine, gangrene perforation, and peritonitis.	Resection 84 cm ileum—end to end anastomosis.	Expired.

inflated with air or distended with saline to determine its suitability for anastomosis. Fourth, the type of anastomosis to be performed depends on the portion of small intestine resected (Fig. 1). Fifth, utmost gentleness in the handling of the intestinal segments cannot be overemphasized. Sixth, the use of 0000 or 00000 silk on atraumatic needles as interrupted sutures.

RESULTS

All the 14 patients covered in this report (Table I) were operated upon in the newborn period. Ten patients survived and were discharged from the hospital, giving a sur-

vival rate of 71 per cent. Of the surviving infants there has been one subsequent death (Case 8), a mongoloid who died suddenly at home one week later of causes unknown. The remaining patients have been followed from 3½ months to six years.

In Table II is summarized the type and number of pathological lesions encountered in this series.

In the jejunal resections of 25 cm. (Fig. 2A) and 26 cm. (Fig. 2B) there were no immediate or late ill effects, as these two infants are now 46 and 28 months old, and weigh 55 and 33 pounds respectively. They have normal height, and have one to two

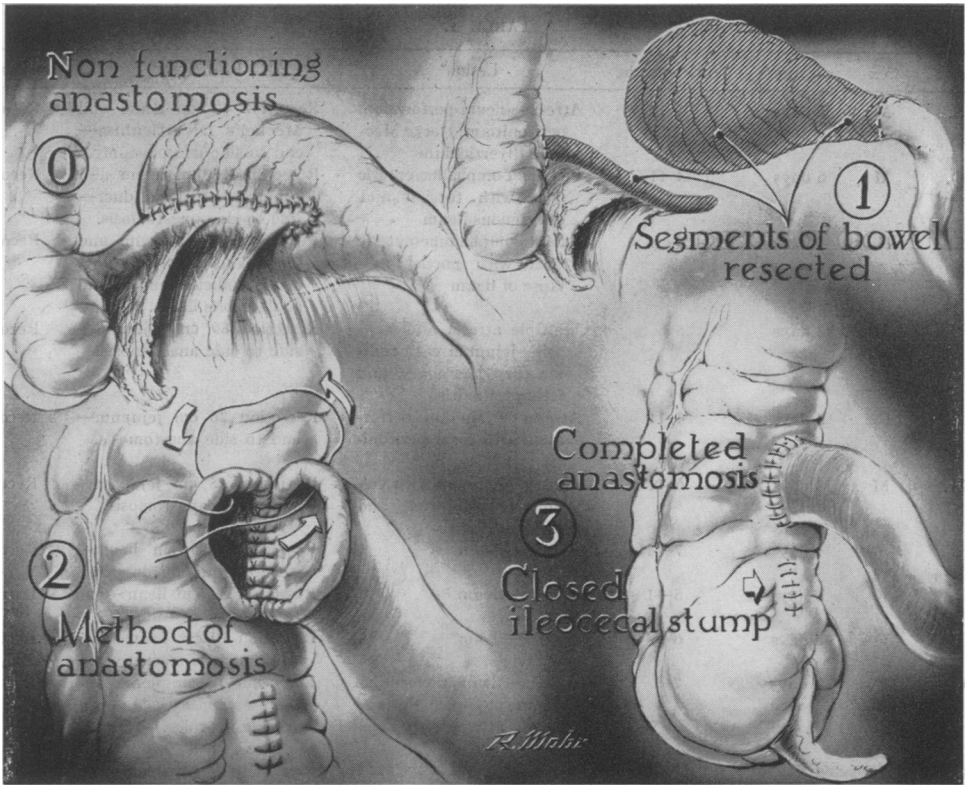


FIG. 1. This type of resection and anastomosis is used for atresia of the ileum near the ileocecal junction. If the atresia is at a higher level, the bulbous proximal segment is excised and anastomosis performed between the remaining segments to preserve as much intestine as possible.

normal stools per day. The most recent resection (Case 4), involving 89 cm. of jejunum, presented a difficult electrolyte problem because of metabolic acidosis during the first month after operation but was controlled by two ounces of sixth molar lactate per day orally, and the feeding of Nutramigen, which provided predigested proteins and dextra maltose. In addition, Lecithin .5 Gm. t.i.d. provided readily absorbed fat, and also an emulsifier. This infant weighed four pounds 11 ounces at the time of operation, and gained only three ounces during the next four weeks. His weight at six weeks was six pounds, and at two months (when he was discharged home) six pounds six ounces. At four months, he weighed eight pounds 14 ounces, and had six to seven loose stools per day until strained vegetables and cereals

were added to his diet. He now has three to four formed stools per day.

TABLE II.

A. Type and Number of Lesions.	
(1) Jejunal and Ileal atresias.....	10
(2) Malrotation, Volvulus with perforation.....	2
(3) Persistent Omphalomesenteric Duct with partial prolapse of ileum.....	1
(4) Persistent Omphalomesenteric Duct with torsion and gangrene—ileum.....	1
	14
B. Method of Anastomosis.	
End to side.....	6
Side to side.....	6
End to End.....	2
	14
C. Length of Small Intestine.	
Resected With Survival.....	12 cm to 89 cm.

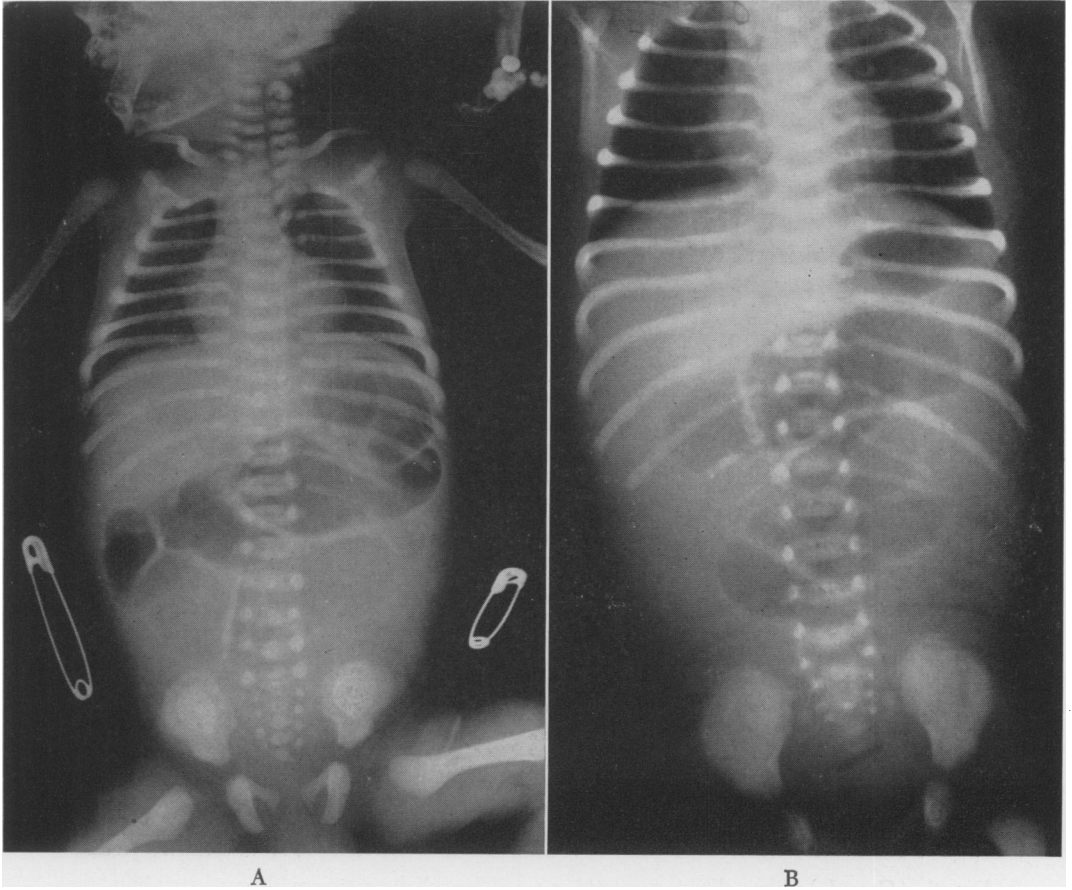


FIG. 2. (A) (Case 6.) Film showing distended proximal jejunum. (B) (Case 5.) Film shows jejunal distention.

In the resection of the ileum, removal of 12 cm. to 36 cm. was tolerated but with some diarrhea and failure to gain weight normally for the first three months. Subsequently they all have gained weight and height normally for their respective ages. Case 1 (Fig. 3), in whom 42 cm. of terminal ileum was resected and an ileocolostomy was performed, had loose stools for only one month, then adjusted to normal habits. At the age of three years his weight is 39 pounds, his height 38 inches, he has one normal stool per day, and is on a regular diet.

Case 10 (Figs. 4 and 5) presented a most unusual finding at operation—an atresia of the ileum, no terminal ileum, appendix or cecum, and the ascending colon was at-

tached to the umbilicus. We have not encountered a similar case in the literature. As illustrated in Figure 5, 18 cm. of the bulbous proximal segment and 3 cm. of colon were resected followed by an ileocolostomy. She had some diarrhea for three months, gained weight slowly, and she was given Nutramigen every four hours. Her birth weight was seven pounds five ounces, and at three months she weighed nine pounds ten ounces. At four months her diarrhea had abated, and she was placed on a regular formula. At last report at seven months of age her weight was 17 pounds two ounces, and height 27 inches. She has two normal stools per day, and her progress has been satisfactory.

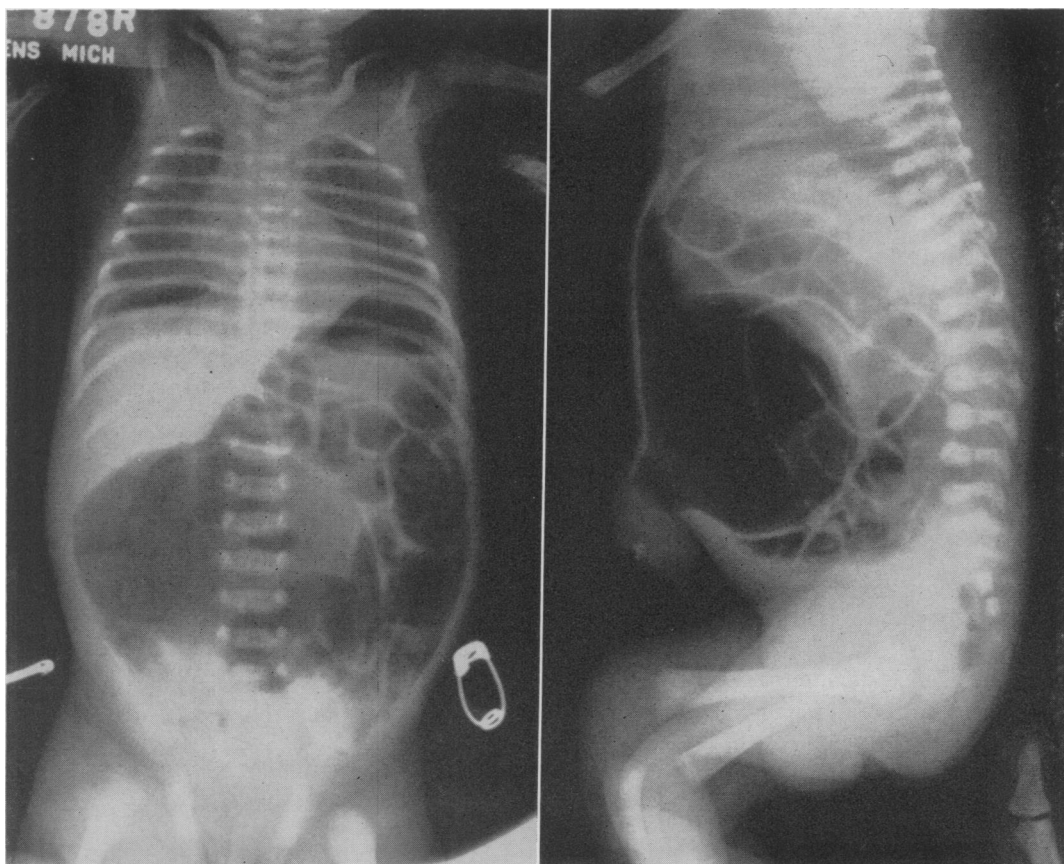


FIG. 3. (Case 1.) Films showing extensive small bowel distention with gas extending into the umbilicus and free air under both diaphragms.

Case 3 (Figs. 6 and 7) presented an unusual anomaly in that there was periodic partial prolapse of the ileum through a large patent omphalomesenteric duct. Resection of the umbilicus, omphalomesenteric duct and 12 cm. of attached ileum was followed by an end-to-end anastomosis. This patient had no diarrhea postoperatively, and at the age of 30 months his weight is 34 pounds, and his height is 36 inches.

OPERATIVE MORTALITY

Of the 14 patients operated upon in the newborn period there were four deaths: Case 11, a full term infant who had 19 cm. of ileum, including the blind ileal pouch, resected and ileocolostomy performed. He developed small bowel obstruction from adhe-

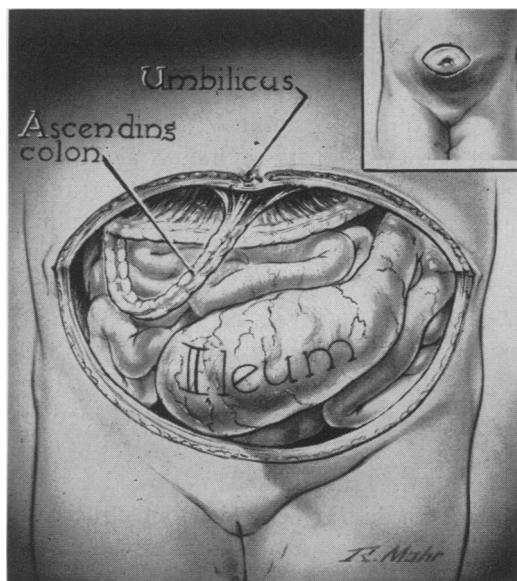


FIG. 4. Case 10.

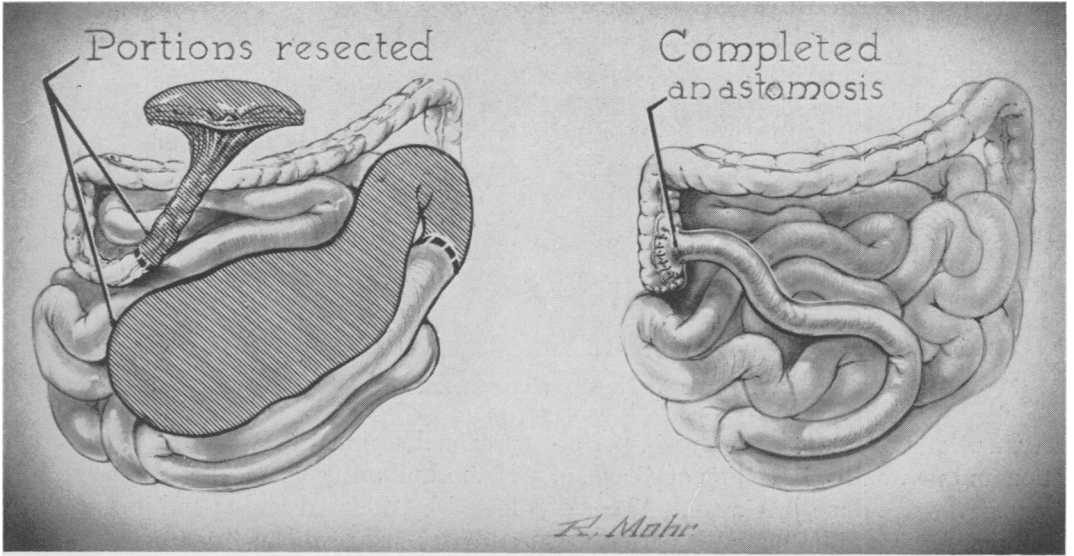


FIG. 5. Case 10.

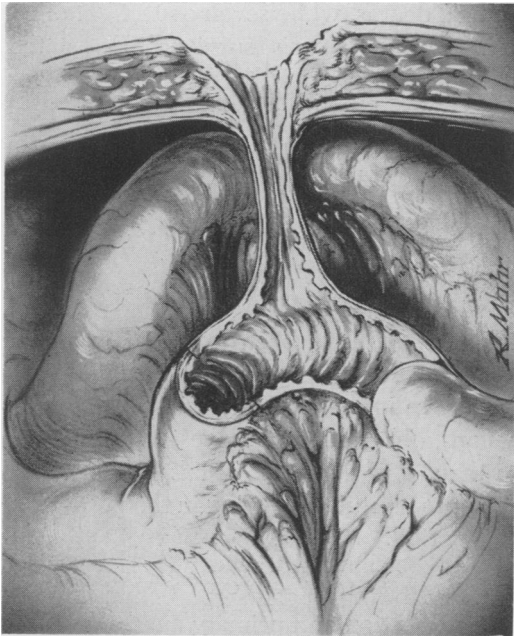


FIG. 6. (Case 3.) Patent omphalomesenteric duct through which there was periodic prolapse of ileum.

sions, and a small bowel fistula. At a second operation the jejunum was adherent under the operative wound. The fistula was resected and an end-to-end anastomosis per-

formed three weeks after the original operation, but the patient died suddenly with convulsions two days postoperatively. Postmortem examination revealed old peritonitis and multiple adhesions.

Case 12, a premature male infant, was found at operation to have malrotation, volvulus, necrosis of the small intestine with perforation of the ileum with peritonitis. Resection of 84 cm. of the jejunum and ileum was performed but a small bowel fistula occurred seven days postoperatively at the line of anastomosis. Secondary closure of the fistula was carried out three weeks after the original operation, but the patient died three days later of *B. coli* bacteremia.

Case 13, a full term female infant, had 75 cm. of ileum resected for multiple atresias of the ileum and a side-to-side anastomosis performed. Re-operation was performed two weeks later because of obstruction of the distal loop due to adhesions, but the patient expired suddenly the next day. Postmortem examination revealed chronic peritonitis, and the suture line was intact.

Case 14, a premature, 4-day-old infant, found at operation to have all of the small bowel in a mass, with rudimentary mesen-



FIG. 7. (Case 3.) Photograph two months postoperatively.

tery, malrotation, volvulus, necrosis, perforation and peritonitis. Resection of 41 cm. of small bowel was done, leaving only 18 cm. of jejunum. A jejunocolostomy was performed, but the patient died the next day of extensive peritonitis compatible with fetal peritonitis.

DISCUSSION

In our experience with eight other newborns with atresia and stenosis of the jejunum or ileum, who had only side-to-side anastomosis performed without resection, we had four survivals. Of the four survivals, two infants developed a blind loop syndrome of diarrhea, abdominal cramps, and weight loss at 11 and 23 months respectively. They were completely relieved of their gastrointestinal symptoms following resection of the distended blind pouch and anastomosis, and an end-to-end anastomosis performed. From these experiences and findings at post-mortem of the proximal blind pouch used in the standard side-to-side anastomosis, we were convinced that to obtain better results in atretic lesions of the jejunum, and especially of ileal atresias, our method of handling these lesions had to be changed. Our present method is essentially that reported by Snyder, Voskamp and Chaffin⁶ in 1950 for ileal atresias. These authors reviewed the world literature and found only 20 successfully treated ileal atresias, and added five successful cases in their report. Swenson⁷ has reported a quite similar procedure of

proximal segment decompression, resection of the bulbous proximal ileal segment, followed by a closed end-to-end anastomosis, and was successful in three of four cases. Gross,³ in the period 1940 through 1952, treated 20 ileal atresias by the Mikulicz double enterostomy, and showed 14 survivals and six deaths, while seven of 18 treated by primary anastomosis survived. He stated these figures seem to be distinctly in favor of the exteriorizing procedure for the ileal obstructions. In all small bowel surgery in the newborn the formation of postoperative adhesions is still a formidable complication which contributes to our morbidity and mortality, and they still occur in spite of chemotherapy. This has been particularly true of infants who have been operated upon for perforated obstructions and associated peritonitis. In primary anastomosis in the latter lesions, obstruction by adhesion at or distal to the site of anastomosis has been a major factor in a fistula occurring in the postoperative period.

SUMMARY AND CONCLUSION

1. Resection and primary anastomosis for certain obstructive lesions of the jejunum and ileum is feasible in the newborn.
2. Resection of the bulbous, hypertrophied blind pouch in atresias of the jejunum or ileum is necessary to obtain a functioning anastomosis.
3. In resections of the jejunum and ileum, infants will tolerate greater length of jejunal

segment removal than ileal segment without affecting growth and development.

4. In resections of the ileum, removal of 19 to 42 cm. will produce disturbance of diarrhea and slow weight gain, but adjustment usually takes place in three to four months.

5. In this group of 14 patients in the newborn period with acute obstructive lesions of the jejunum and ileum, five had perforation of the intestine and three survived. Of these five, three were prematures and two survived.

6. Perforated lesions are very prone to produce adhesions and obstruction in the postoperative period, and are important factors in the morbidity and mortality of this particular group of patients.

7. The nine surviving infants have been followed from three and a half months to six years, and are showing satisfactory growth and development.

8. From this study the segment of small

intestine which can be removed with survival and no apparent ill effects is 42 cm. of ileum and 89 cm. of jejunum.

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DISCUSSION.—DR. GROVER PENBERTHY, Detroit, Michigan: These two papers represent a contribution to pediatric surgery, and anyone with experience as regards anastomosis of the intestine realizes the technical difficulties encountered in trying to develop a successful anastomosis in these infants, where there is a discrepancy between the greatly distended proximal segment and a small and often-times underdeveloped distal segment.

The successful ileo-atresias up to 1950 numbered 20, as reported by Snyder and Chaffin, which illustrates no doubt the difficulties encountered in accomplishing a successful result in this type of lesion.

In Dr. Benson's presentation it is interesting to note that of the 14 cases of obstruction ten were due to atresia of the jejunum or ileum. Eight of the ten atresias survived and were discharged from the hospital. The follow-up study shows that one, a mongoloid, subsequently died suddenly at home of causes unknown.

It is also interesting to note that in this series of 14 cases five had perforation and peritonitis at the time of surgical intervention. Three of the five survived. This survival rate reflects not only the

technical management, which includes the delicate handling of the bowel to prevent injury to the serosal covering, but also the availability of improved anesthesia, chemotherapy, and the use of blood and fluids as indicated in the pre- and post-operative periods in these critically ill newborn infants.

DR. FRANK L. MELENEY, New York, N. Y.: Neither of the last two essayists has mentioned the factor of infection in the success or failure of these cases. I am glad Dr. Penberthy mentioned, incidentally, chemotherapy and antibiotics. I would like to ask the essayists what they think the advent of the antibiotics has been as a factor in improving the favorable results in these cases.

DR. CLIFFORD D. BENSON, Detroit, Michigan: I would like to thank Dr. Penberthy and Dr. Meloney for their discussion.

There is no doubt that chemotherapy certainly has been a great aid in these patients. In spite of chemotherapy, however, we still have the difficulty of postoperative adhesions, and this has been one of the main factors in morbidity and mortality.