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Ileostomy in pediatric patients

Lloyd D. Smith
University of Nebraska Medical Center

ILEOSTOMY IN PEDIATRIC PATIENTS

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Lloyd D. Smith

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The total management of any patient requiring an ileostomy offers many problems, and when these are combined with a pediatric patient, these are greatly increased. This paper is an attempt to review some of these problems and their answers. The eight recorded cases at the University of Nebraska Hospital and the Childrens Memorial Hospital are reviewed and reported.

The first problem, as ever, is found in the indications for the operation. In the texts ileostomy is listed as possibly required in several diseases including ulcerative colitis, congenital intestinal atresia, meconeum ileus, severe volulus, and severe megacolon. Of these, ulcerative colitis is by far the most frequent cause. The general surgical texts of Colcook writing in the Surgical Practice of The Lahey Clinic, and in several journals, Dennis writing is Cole's book of General Surgery, Shackelford's new book which quotes Dennis extensively, and the many articles in various journals including those by Lyons & Garlock, Turnbull, Brooke, and many others, discuss the operation only as regards the ulcerative colitis patient.

Gross in his book of Pediatric Surgery lists 32 cases of ulcerative colitis for which ileostomy was done and only 2 or 3 cases of each of the other causes. In his patients with ulcerative colitis, Gross reports perforation, abscess, peritonitis, strictures, and superimposed malignancy as having been indications for ileostomy but because of the

young age of his patients, he urges the use of prolonged medical therapy before this operation is used, but at the same time, because of the definite therapeutic effect of rest for the colon, he advises use of the operation before permanent damage is done to the colon and uses X-ray evidence of shortening, loss of haustrations or poor distensibility of the colon as indications for ileostomy.

There are many differences between the ileostomy done for ulcerative colitis and the other diseases simply because the rest for the colon must be long term and in many cases it is permanent. The ileostomy must then be done so that it too can be permanent, if necessary. To begin with, attention must be given to the location of the ileostomy. The discharge for many weeks is liquid and at best may become only semi-solid. It is also discharged almost constantly with only feeble attempts at bowel movements shortly after meals, and it contains many digestive juices that are irritating to the skin. The patient, therefore, has to wear a collective receptacle at all times. There are several types of these but the basic pattern of a flexible bag with the opening fitting snugly around the ileal stump placed in a wide flange that fits flush against the skin is common to all. The bag is held in place with one of several types of adhesive pastes and with a belt around the waist.

The fact that the flange on the bag is several inches in diameter and fairly stiff must be considered when planning

the site of the incision because it must not rub against bony prominences and the skin upon which the flange is to be fastened must be smooth. Either a small McBurney incision or a separate stab wound in the middle of an adequate area of smooth skin is thus required. Usually a stab wound in the right lower quadrant is used.

All of the above features are mentioned repeatedly by all of the previously mentioned authors. All of them also agree quite well on the proper technique to be used and quote Dennis extensively. Shackelford describes the technique in most detail and most of the following is taken from his book. He uses a right mid-rectus incision but he is referring mainly to adults and I personally wonder if an incision more to the left of the abdomen would not be preferable, in the pediatric patient.

The abdomen is not explored and all unnecessary manipulation of the fragile bowel is avoided to prevent rupture and peritoneal soilage. If the disease process has extended up into the terminal ileum, Gross and Colcock recommend that the bowel be transected at least three inches above the most proximal diseased area. They, and Shackelford all agree that a colostomy should not be done even if the proximal colon is not involved because of the high incidence of new disease in the remaining functioning colon. Shackelford recommends resection of a segment of ileum at the proposed site of transection for immediate microscopic examination

for evidence of disease. If positive, repeated resection of small segments are done until disease free bowel is obtained. The ileum is transected between clamps and, as Colcock recommends, the mesentery is divided between the first and second archades for several inches proximal to the site of transection. Colcock divides the mesentery before transecting the bowel. The proximal end is then brought through the stab wound in the right lower quadrant so that it protrudes from the skin for at least two inches.

Dennis places 10-12 silk sutures through the transversalis fascia and peritoneum of the stab wound before the ileum is pulled through. He leaves these sutures long until the ileum is in place and then uses them to anchor the bowel to the abdominal wall using sub-mucosal stitches in the bowel. These sutures are placed to avoid prolapse and rotation but Shackelford, Turnbull, and Colcock prefer not to place sutures in the bowel wall because of the danger of entering the mucosa and allowing a small fistula to develop. They do, however, use several sutures to tie the mesentery to the inner layers of the abdominal wall and feel that that, plus wrapping the ileum with boric ointment gauze or even dry gauge provides rapid and complete enough adherence and fixation of the stoma. The stab wound and original incision are closed in layers. The opening left for the stoma is important and varies with patient's size. The proper size in the adult is felt to be just large enough to accom-

modate two fingers but no recommendations are made for the pediatric patient.

What to do with the distal end of the bowel is a much discussed and debated point and is tied in closely with the problem of whether immediate total colectomy should be done. All of the previously listed authors admit that they are doing total colectomy more frequently now than previously but there is a definite tone of reluctance to submit the patient to so permanent a procedure. Gross is especially reluctant with pediatric patients and frequently brings the distal opening to the surface of the original incision.

Additional points of technique used by some include the following:

(1) A soft rubber catheter is usually placed in the proximal ileum for about 6-10 cm. The technique of Dennis calls for this to be done several hours to 2 days post-operatively but Colcock recommends that it be done before the ileum is anchored or at least while the patient is under anesthesia because the immediate post-operation edema can make it difficult to pass the tube and the active peristalsis makes it painful. This would seem to be especially important with the smaller lumen in a pediatric patient.

(2) Since most patients are emaciated, Dennis and Colcock both recommend that the skin be sutured relatively high on the stump using sub-serosal sutures to avoid scarring-in that would leave the stoma in a depressed scar

after the patient regains weight. This too should be especially important in growing children and is associated with the necessity of leaving a long ileal stoma of at least one inch as recommended by Dennis, Shackelford, Colcock, and Gross and of one and one-half inches by Turnbull.

(3) Crile, in Turnbull and Shackelford inverts the stoma suturing mucosa to skin. The purpose for this will be discussed later. This procedure results in a single end, more permanent type of ileostomy. It could conceivably be necessary to use this operation in a case with complete colon atresia or in very severe megacolon. The other, more rare, diseases requiring ileostomy differ in that the surgery is a temporary measure or an emergency decompression. The technique used is simpler and faster. Usually the operation is done on the newborn infant because of bowel obstruction from intestinal atresia, meconium ileus, or malrotation and is done as soon as the diagnosis is made. In an older child it may be required because of an acute exacerbation of ulcerative colitis and here the indications are extremely indistinct but, as Colcock states, don't wait until extreme dehydration and malnutrition are reached.

Temporary ileostomies are divided into two similar types differing as to whether a tube is used or not. The Witzel procedure, in Shackelford, is the standard one in which a tube is used. A soft rubber catheter is sewn into

the bowel with a purse string suture and then overlain with bowel wall so that a short tunnel of bowel wall closely surrounds the tube which lies parallel with the bowel and decreases leakage. Only the tube is brought through the incision, which is usually a McBurney incision and the bowel remains loose in the abdomen. Decompression is accomplished but re-operation is required.

Occasionally the distension is so great and the patient's condition so poor that a Mickelic's type of procedure has to be done. The technique is the same as for a colostomy with an entire loop of bowel brought out and held in place with a glass rod, a catheter, or with skin sewn under the loop. The bowel can be opened with a slit if spontaneous closure is to be desired in the future or the loop can be transected to produce a double barrel type of ileostomy. Having the distal end out is also desired with meconeum ileus so that the distal bowel can be irrigated and the meconeum removed. This procedure also allows exteriorization of gangrenous bowel before removal and decreased peritoneal soilage. Both of these two types of operation allow speed and ease of operation in the critically ill patient and provide decompression and diversion of the digestive stream for days or weeks as required.

All of the foregoing discussion also shows that we are seldom dealing with a set pattern with any specific patient. The diagnosis, the severity or degree of disease, the

patient's age and condition, the duration of the disease, and the type of ileostomy required are all of immense importance and vary greatly.

At first the complications from ileostomy were many and severe. Lyons & Garlock reported major complications in 47 out of 145 patients, or 32% in adults. I found no figures for pediatric patients but it would be improbable that the percentage would be less. The following are the major complications frequently encountered:

(1) Obstruction. The problem of obstructions is also multiple. Lyons & Garlock, Turnbull, and Brooks all report that there is almost always an incomplete obstruction occurring 2-4 days post-operatively due to edema of the distal few inches of the stoma. This is occasionally severe enough to prohibit passage of feces but seldom is complete to even the passage of gas. Brooke uses the failure to pass gas in the relatively early post-operative period as an indication for re-operation. Turnbull is quite definite in stating a specific sequence of events with obstruction starting with: 1. A constant ileostomy drainage. 2. A watery, brown, foul smelling discharge. 3. Fleeting cramps--all due to bowel attempts to overcome the obstruction. 4. Loss of appetite. 5. Occasional visible peristalsis. 6. The empty bag with complete obstruction. Lyons & Garlock agree that obstruction is initially heralded by excessive watery discharge and cramps, and both of the latter sets of authors

use continued cramps and/or patient decline as indications for re-operation. Usually, however, insertion of a lubricated catheter past the distal 6-8 inches produces relief within several days; the edema subsides and normal peristalsis is resumed.

The various causes for mechanical obstruction include kinks, volvulus, herniation internally, adhesions and stenosis, and all are now fairly well preventable. Colcock emphasizes that the ileum be freed from the mesentery for at least 3 inches to avoid a sharp curve as the ileum passes through the abdominal wall. The suturing of at least the mesentery to the internal layers of the abdominal wall is emphasized by almost all of the previously listed authors to prevent rotation. Colcock closes the lateral gutter with omentum, especially if colectomy is also done to prevent internal herniation. Stenosis is best dealt with by daily dilatation using a catheter or the gloved finger whenever it first becomes evident.

(2) Infection. The most frequent cause for infection as given by Colcock, Turnbull and Shackelford is manipulation of the bowel of the ulcerative colitis patient with rupture of the extremely friable bowel wall. Again the treatment of colitis is prevention by absolute avoidance of manipulation of the bowel.

A second phase of the infection problem occurs at the site of the exteriorization where the incision through the

peritoneum allowed bacteria to enter the abdomen more easily. Only Brookes makes a definite statement about the role of the serosa as the specific route of spread into the abdomen but several other authors allude to it. The loose serosal tissue is more susceptible to infection and allows easier spread. The more recent authors not only recommend that the serosa be protected but state it as a definite part of the technique. Turnbull uses a gauze wrapping around the stump for the first four days. Dennis, in Shackelford, and Crile, in Turnbull, evert the stump and suture the mucosa to the skin with the initial surgery. Skin grafting has also been tried but has not proven successful and is only listed as possible by Shackelford.

(3) Skin excoriations once were among the major problems of the long term ileostomy patients. The constant discharge of digestive juices on the skin produced large, raw, areas of flesh with pain, infection, and ever many suicides. Here also, technique is important in preventing this problem. Placement of the stoma on smooth skin, making the stoma approximately one inch long so that the discharge is deposited directly into the collecting bag, suturing the skin up onto the ileal stump as previously described to prevent retraction into the abdominal wall, all allow the satisfactory use of the newer collecting receptacles.

The very development of the newer collecting receptacles has also aided greatly in this problem. The Kornig-Rutzen

bag which is made of soft rubber and has the wide, flat, firm rim around the opening is typical. The rim fits snugly to the skin and the stoma and does not allow the discharge to come in contact with the skin. The adhesive paste used to fasten the bag in place has a hydrocarbon base and Turnball states that it must be allowed to dry completely or it is irritating to the skin. He also advises against changing the bag more often than every other day because some epithelium is pulled loose each time the bag is removed.

If excoriations occur, Shackelford recommends the use of Ladd and Gross paste consisting of aristol 100 parts, castor oil 600 parts, zinc oxide 320 parts, and petroleum 1280 parts, or aluminum paste containing metalic aluminum 25% in petroleum. Turnbull uses Karoya Powder sprinkled on the exudative area which makes a paste that dries to a firm protective coating. This has the advantage that the regular paste and bag may be used over it.

With extremely severe excoriations a tight fitting catheter can be inserted for drainage but Shackelford cautions against leaving the catheter in too long because of the possibility of erosion of the bowel wall and recommends a 4 hour in and 1 hour out schedule. The extreme case can be handled by placing the patient upside down in a Bradford frame with the ileal contents emptying directly downward, but this extreme is reported to be encountered only extremely rarely.

(4) Prolapse is also a surgical complication that has been fairly well overcome and prevention is again the major feature. Suturing of the mesentery to the transversalis and peritoneal fascia while closing is the major feature used by most authors. Dennis, of course, also uses the sutures placed in the bowel wall. According to Turnball and Brookes, the proper size of the stab wound plays a secondary role with the two finger rule applying to adults. No definite size is, or probably would be, listed for the variable sizes of the pediatric patients. The flange of the ileostomy bag and the waist strap are also of minor assistance in providing support. If prolapse occurs reoperation with re-fixation of the mesentery or, if severe, or recurrent, transplanting of the ileal stoma to a different section of the abdomen is indicated.

(5) Fistulae are formed by erosion through the ileum below skin level and out through the surrounding skin. With a fistula the major problems are collection of the drainage and infection. The most frequent cause, according to Shackelford and Colcock, is the misplacement of a suture through the mucosa using Dennis' technique. For this reason, they no longer recommend that sutures be placed in the bowel itself, as has been previously mentioned. Turnbull suggests that irritation from the ridge of a bag on the non-mature stump can cause fistulae. He uses the term non-mature to describe a stump which has not had the mucosa everted to meet the skin or one in

which the scar tissue over the scrosa has not hardened and contracted. This is a second reason why most authors recommend eversion of the mucosa to skin. Crile, in Turnbull, reports that eversion shortens the maturation process from 3-4 weeks to 5-7 days. Turnbull, also uses the Talbot collecting bag for the first few weeks. It has removable flanges which may be obtained with varying sized openings, some of which are larger than required to avoid any rubbing while the stoma is immature.

(6) Enteritis. Lyons & Garlock report a 4.1% incidence with symptoms consisting of a foul discharge, explained loss of appetite, low grade fever, and early signs of obstruction and occasionally blood in the fecal discharges. Antibiotics are usually successful in controlling the infection.

(7) Retraction of the stoma occurs in 3.4% of patients to a degree that it becomes troublesome according to Lyons & Garlock's figures for adults. Retractions is stated by them to be due mainly to scarring and can generally be overcome with suturing the skin high on the long stoma, as was previously described, in anticipation of scarring, weight gain, and growth. Revision of the stoma may still be occasionally required.

The fluid balance problem associated with pediatric surgery, and especially with ileostonies were my initial interest in this topic. There has, however, been very little

written about the specific problems encountered and, as we have done with technique and surgical complications, we are forced to use generalities and to try to interpolate from adult studies.

The facts that infants and children tolerate imbalance of water and electrolytes much less readily and that their means and methods of maintaining the proper balances are much less capable are well known. Gamble gives the classical example in the comparison of the 7 kg. knfant with a total extra cellular fluid of 1400 cc. and a 700 cc. daily intake and output for a 2-1 ratio with a 70 kg. adult having 14000 cc. of extra cellular fluid but a daily intake and output of 2000 cc. for a 7-1 ratio. Harding makes it even more apparent with the illustration that 50 cc. in a premature infant is approximately one-fourth of his circulating blood volume and a deficit of this amount can produce serious results, especially in the face of surgery. It is also easy to see that major fluid and electrolyte derangements could occur in the diseases leading to the necessity of performing an ileostomy and from the complications of the surgery.

Several generalities which always have to be considered with pediatric patients include the fact which Hardy, Hastings, Frank & Brophy and Nielson's text emphasizes, that the kidneys of an infant up to one year of age are immature in their ability to conserve salts. In the newborn sodium is

excreted at only one-half of the adult maximum. Increased adrenal activity in the face of stress is also a factor that would tend to increase sodium retention but how effective this is in the infant has not been clearly defined. A technical problem in the small patient and especially the infant is that serum electrolyte determinations are seldom available or practical. The amount of blood required for these determinations usually cannot be spared, at least not repeatedly, and clinical judgment has been the major feature governing therapy.

There are two other generalizations which can, however, be made about any fluid balance problem: 1. you must give the normal daily requirements and 2. you must replace any and all abnormal losses. There are many authors who give tables listing the various normal daily requirements and the one given by Frank, Hastings and Brophy agree well with most of these.

Normal Daily Maintence Requirements

AGE	CALORIES/Kg.	GRAMS PROTEIN/K	c.c. WATER/Kg	meq. Na^+ or Cl^-/kg.	meq. K^+/Kg.
3 days	110	4	90	0.88	1.1
10 days	110	4	135		
3 months	110	4	150		
6 months	110	4	145		
9 months	110	4	135		
1 year	110	4	130		
1-3 years	100	3.5	125	0.80	1.0
4-6 years	90	3.0	100	0.72	0.9
7-9 years	80	2.5	75	0.64	0.8
10-12 years	70	2.0	75	0.56	0.7
13-15 years	60	1.5	50	0.48	0.6
15+ years	50	1.0+	50	0.40	0.5
ADULT	40	1.0	45	0.32	0.4

If a table such as this is not immediately available, Hardy recommends the use of the hematocrit and daily weighings to guide the amount of fluid given and since the type and source of loss is usually known most patients can be handled quite well.

The abnormal losses of the patient requiring ileostomy are quite variable both in type and amount. Pre-operatively, the problem is usually one of intestinal obstruction from congenital atresia, meconeum ileus, or volvulus, or of chronic diarrhea from ulcerative colitis. Harding points out the problems peculiar to small bowel obstruction quite well. He is referring mainly to adults but the same problems should also be present in children. The major feature, as emphasized by Wangensteen, in Hardy, is that with obstruction the normal secretions are not reabsorbed and accumulate rapidly in the bowel. In uncomplicated obstruction, the accumulated fluid is very similar to plasma as regards minerals and acid-base balance, but most cases are complicated by severe vomiting and/or intestinal intubation and suction. If the suction is from the intestines, the lost fluid is also very similar to plasma, but if it is from the stomach, the problem is similar to that with the initial vomiting, or worse since the lost gastric juice contains relatively higher concentrations of chloride and predominant loss of gastric fluid rapidly produces severe alkalosis. In the adult gastric juice is reported by Hard-

ing to be hypertonic with respect to chlorides but both Hill and Nelson state that in the pediatric patient it is isotonic with the other elements being hypotonic, except K which is present in concentration of 5-15 meq./L. according to Hill. In any case, with severe vomiting and obstruction, dehydration and alkalosis can become severe. Potassium is lost in large amounts and features of malnutrition occur, with lethargy, shallow respirations and even alkalotic convulsions developing rapidly.

The changes may be rapid enough so that compensatory increase of bicarbonate cannot occur. The malnutrition produces ketosis and the severe dehydration produces curtailment of renal function with retention of sulfates and phosphates so an actual acidosis may occasionally be present. Because of these features and the fact that the child has lower concentrations of plasma proteins, (according to Frank, Hastings, and Brophy), to act as buffers, the use of ammonium chloride solutions must be cautious. Pre-operative therapy must then consist of giving the following:

1. Large amounts of water to allow renal compensation.
2. Glucose. Hill states that 3-5 grams per day are required to prevent ketosis.
3. Small amounts of potassium. Usually this is not required pre-operatively, especially if renal output has been curtailed.
4. Small amounts of ammonium chloride, usually as a

M/6 solution. The standard formula given is that 4.2 cc./kg. will lower the carbon dioxide combining power one meq./L. Usually only one-half of the calculated dose is given initially and Hill cautions against the giving of more than 30 cc. per kg.

5. Hill recommends that small amounts of whole blood be given but usually not more than 10 cc./kg.

These solutions are given I.V. to restore balances and prevent shock.

Oral feedings of sterile electrolyte solutions such as Ringers solution and glucose can usually be begun after 12 hours and formula or solid foods after 48 hours, according to Hill. This, at least, is the usual plan with abdominal surgery. If vomiting persists, pre-operative therapy is continued, with the addition of larger quantities of potassium after renal function is reinstated.

Pre-operative fluid therapy may not be required in the patient with ulcerative colitis, but in an acute episode output via the colon may easily exceed oral intake and anorexia and vomiting may also be present. It has long been a clinically known fact that diarrhea produced acidosis and dehydration through loss of relatively more sodium than chloride and Field, Dailey, Boyd & Swell, working on dogs, found that though there was an unexplained mechanism which attempted to maintain the osmolarity of the ileal contents

and that all segments of bowel could absorb most minerals the small bowel was the major site of absorption for potassium and the colon the major site for sodium. With an acute episode, the problems of dehydration and renal shutdown and of malnutrition with ketosis are also present, but in this case they augment the acidosis to produce the symptoms of shock and hypernea.

The use of the standard solution of M/6 sodium lactate to relieve the acidosis is widely advocated. Again the standard adult formula is to give 4.2 cc./kg. to raise the carbon dioxide combining power one meq./L. giving it in divided doses of one-half the calculated dose I.V. initially and then giving one-fourth of the dose subcutaneously at 4-6 hour intervals if renal function is good. Hill again uses 30 cc./kg. as the maximum amount to be given I.V. in the initial therapy. Surgery usually need not be delayed after the initial therapy is given if a good clinical response is obtained. Hill also advised the use of 5-10 cc./kg. of whole blood pre-operatively to combat shock, and in the malnourished or even bleeding ulcerative colitis patient this would be especially important. Pickering & Winters estimate that a severe diarrhea with clinical signs of dehydration to the extent of producing loss of skin turgor, prostration, sunken and soft eyeballs, oliguria and shock produces a fluid loss of approximately 12-15% of body weight and they recommend that after the initial fluid to combat

shock and acidosis are given, this deficit be replaced with normal saline in 5% glucose.

Post-operatively, oral feedings are begun early; usually liquids after 12 hours and solids after 48 hours. If this is possible, fluid and electrolyte problems should not occur, but if oral intake is not possible pre-operative fluid therapy may be continued with the addition of two features. With diarrhea and acidosis, potassium is lost in large amounts. Pickering & Winters state that diarrhea fluid contains an average of 8-12 meq./L. of potassium and they and Hill and Hardy all emphasize the fact that a potassium deficiency greatly hinders restoration of acid-base balance. This deficiency can partly be made up pre-operatively with the use of Ringers solution or even Ringer-Lactate for the initial therapy though these solutions contain a third less sodium chloride. These solutions are more strongly recommended for less severe diarrhea by Hill and by Pickering & Winters in amounts up to 30 cc./Kg. but it seems to be a matter of personal preferences with Frank, Hastings & Brophy recommending the use of a two part Ringers to one part 5% glucose solution. Usually, however, the addition of extra potassium is required with the addition of 2-3 meq./Kg. per day of potassium to the maintenance fluids. It is usually given as potassium chloride and 1.0 grams provides 13.4 meq. of potassium.

The second point concerns calcium replacement. With

acidosis of any degree calcium is mobilized and also converted from the ionic form and none is absorbed. The acidosis is corrected more rapidly than the calcium deficiencies and tetany may occur. The diagnosis of calcium deficiency is a clinical one because the chemical determination may be within normal range with the relative ionic deficiency being severe enough to produce a positive Chvostek's sign and/or carpal spasm (Trousseau's sign). Hardy discusses this quite well and states, in adults, that a serum calcium level below 8 mg. % may produce tetany and he recommends giving up to 10 cc. of 10% calcium gluconate I.V. at a time to prevent symptons. With a little time, enough calcium is mobilized from the bones to restore blood levels to normal. Hill also states that alkalotic convulsions are due to a plasma decrease in ionized calcium and recommends that it be given in cases of vomiting severe enough to produce convulsions.

The only specific recommendations about post-operative fluid and electrolyte care of ileostomy patients was a recommendation by Brookes that extra salt be given orally if the patient had an episode of diarrhea as caused by partial obstruction or enteritis.

There are several general features which are best presented by Hill about post-operative pediatric patients. First, the blood and fluids lost at the time of surgery must be replaced, including the possibly large amount of perspiration lost while lying under drapes under hot surgical

lights. Blood is replaced by blood and perspiration by hypotonic saline. The use of antibiotics and vitamins, especially vitamin K to all newborn infants, is considered routine, and a recommendation that was frequently encountered was that after initial fluid therapy to combat shock, acidosis, or alkalosis has been given I.V., the maintenance therapy be given by sub-cutaneous clysis. As tissue tugor approaches normal, absorption from a clysis is slowed down so that over hydration is not so easily accomplished. Clysis is ineffective in shock with vascular collapse and I.V. fluids are required then, but entirely adequate amounts of fluids and electrolytes may be given by clysis for maintenance.

The following eight cases of ileostomies done at University Hospital and Childrens Memorial Hospital illustrate many of the points and complications which we have considered.

(1) P. B. was age 5 days when admitted to C. M. H. on 11-17-'50. Her weight on admission was 5 pounds but she had been born 3½ weeks prematurely. Delivery was normal but there was a definite cloaca and she had had no stools. Surgery was done on 11-20-'50 and a complete atresia of the colon was found and a double loop ileostomy was done. She was taking food well and only one feeding was missed for surgery. Stools from the ileostomy were watery for several days, then semi-solid and occasionally were brown and soft

formed. The patient, though, refused to gain weight and weighed only 4 pounds 14 ounces one month after surgery. Because of this, whole blood transfusions of from 20-40 cc. were given at fairly regular intervals even though the hemoglobin on 12-6 was 16 grams and on 12-24-'50 was 18.0 grams. She developed a pharyngitis on 12-19-'50 with a temperature of 101 that was treated with penicillin, and counts taken periodically after that showed a leukocytosis with a definite shift to the left until her death on 1-11-'51. On the day of her death she developed gasping respiration but her chest was clear and she was thought to be in acidosis. A carbon dioxide combining power taken shortly before death was reported to be 13.5 volumes %. No cause for the acidosis was evident. Autopsy failed to find a definite cause for death.

(2) J. M. age 13 had had a double-barrelled ileostomy approximately one foot above the ileo-cecal junction done out-state 5 days before admission to U. N. H. in November of 1950. Surgery had been required because of gangrenous bowel due to adhesions and he was transferred to U. N. H. for definitive therapy. While hospitalized here he developed a definite infection of the skin surrounding the ileostomy that responded slowly to antibiotics. Several blood studies showed evidence of infection with a high white cell count but electrolyte studies remained normal. He did well generally and after 21 days the ileostomy was closed with an end-to-end anastomosis. Post-operative course was

uneventful and he was dismissed 13 days later. The only follow up was a letter from a correction school in another state stating that he was well but inquiring about the nature of his surgery.

(3) B. H. was admitted to C. M. H. on the day of birth on 5-8-'50 because of bowel obstruction. A high ileostomy was done 4 hours after admission because of a variety of congenital malrotations of the entire gut. One section of the small bowel was found to be gangrenous and was removed. The patient died the day after surgery during an exchange transfusion for erythroblastosis fetalis and autopsy revealed a cerebral hemorrhage as the cause of death.

(4) D. W. was born on 9-20-'49. First admission to C. M. H. was three days after birth because of complete absence of stools. A diagnosis of meconium ileus was made but rectal examination produced bowel movements and he was sent home 10 days later as improved. At home he took only small amounts of formula and required 1-2 saline enemas daily for bowel movements and he was re-admitted 13 days later. Repeat stool examinations confirmed the diagnosis of fibrocystic disease and X-rays taken two days after the second admission revealed a constriction of the sigmoid probably due to megacolon or a congenital web. During the first two days after admission, the patient had no stools in spite of enemas and prostigmine and definite distension developed so a Witzel type of ileostomy was done through a

McBurney incision. Some decompression was accomplished and he had a soft yellow stool the next day, but the ileostomy was considered to be unsuccessful, distension increased and intermittent gastric lavage was instituted after the day of surgery. Formula was continued but he was also given blood to replace surgical loss at the time of surgery and 60-80 cc. of 2½% glucose in ½strength Ringers-lactate daily via clysis. Death occurred rapidly the night of the third post-operative day with shallow respirations that just gradually ceased. He had been afebrile throughout. Autopsy findings included an interstial pneumonia, septic pulmonary embolii, chronic colitis, congenital megacolon, and errosion of the catheter through the bowel wall with peritoneal soilage and infection.

(5) M. S., age 4 months. A diagnosis of cystic fibrosis had been made in an out-state hospital from which he was referred to C. M. H. on 1-15-'55. He was initially hospitalized because of abdominal distension and partial obstruction and a soy bean formula failed to provide relief. At the time of admission to C. M. H. he had a quiet, distended abdomen and X-ray revealed a small bowel obstruction. He was operated on the day of admission and distended bowel filled with a tenacious, putty-like material was found. The cecum was opened with several attempts; most of this material was manually expressed from the small bowel. A tube was sewn into the cecum with a purse string suture and brought

out through a separate stab wound in the R.L.Q. Wangensteen suction was instituted before surgery and he received 100 cc. of blood and 500 cc. of 2½% glucose in ½ strength Ringers-lactate the day of surgery. He received 500 cc. of the 2½% glucose in ½ strength Ringers-lactate daily for two days after which nutramagen formula was re-started, and the Wangensteen suction discontinued. Four days after surgery he had a dehiscence with extrusion of approximately four feet of small bowel. The bowel was washed and replaced and the wound reclosed. Wangensteen suction was re-instituted before this emergency surgery was done but was continued for only a few hours post-operatively. Oral feeding was resumed the next day, and he had received 500 cc. of the 2½% glucose in ½ strength Ringers-lactate. All solutions were given via cut-down done at the time of the initial surgery and left in place until the day after the second operation. Antibiotics were started after the second operation and the cecostomy-ileostomy continued to function well with first a clear liquid discharge and then small soft brown stool after several days. The patient appeared to be doing well until 8 days after the second surgery when he suddenly went into shock and died an hour later after suddenly vomiting a large amount of dark black material. At autopsy he was found to have several focal areas of peritonitis, and esophageal rupture into the left chest with pneumonia and collapse of the left lung.

(6) C. K. S., age 7 was admitted to C. M. H. on 2-10-'55 with a 5-day history of complete large bowel obstruction. She had been diagnosed as having congenital maga-colon for many years but this was her first episode of com-plete obstruction. X-rays confirmed the diagnosis and she was operated the day after admission. A moderate amount of free, straw colored fluid was found in the abdomen and a fecal mass filled the pelvis. A cecostomy was done to pro-vide decompression and a foley catheter was inserted into the ileum for drainage. She started spiking a fever to 104 degrees rectally on the second post-operative day and continued to have a high fever that was partially controlled by aspirin until her death on the 7th post-operative day.

She began taking sips of water on the second post-operative day but she was given a continuous I.V. drip of 2½% glucose in ½ strength Ringers-lactate via cut-down up to a rate of 20 drops/minute for a daily fluid intake of at least 1 liter/day. A levine tube was passed pre-operatively and she lost approximately 400 cc./day via this route. She also had a drainage of about 100cc./day from the ileostomy tube. She was given multiple antibiotics from the day of surgery on. The day before her death she developed a shock like picture and was given one unit of plasma, 20 units of A.C.T.H., 10 cc. of whole a renal extract and 20 meq. of KCl. She became more responsive for the rest of the day but develope respiratory difficulty that p.m. and early the

next morning she had 3 convulsions in quick succession and expired. Both pulmonary embolism and potassium deficiencies were suspected and electrolyte studies were ordered for the next day but were not obtained. Autopsy revealed basilar atelectasis, megacolon, and a breakdown of the cecostomy with diffuse fibrinous peritonitis. The adrenal glands were normal except for lipoid depletion of the cytoplasm of the cortex. The peritonitis was considered to be the cause of death.

(7) E. L. A., age 2 months had had surgery 6 days after birth due to complete 360 degree volvulus with obstruction. The volvulus was corrected and he did well until the day of admission to C. M. H. on 9-21-55. He had vomited all feedings that day. Emergency X-rays confirmed the diagnosis of obstruction and surgery was done at 2 a.m. the next day. A greatly dilated bowel filled with gas and a white material described as curdled formula, many adhesions and generalized peritonitis were found. Ileostomy was required to decompress the bowel and close the abdomen. A Mickilicz type of procedure was done. Penicillin and streptomycin in huge doses were started but he died at 1:45 p.m. the same day in respitory collapse in spite of caffeine and oxygen. He was given 500 cc. of fluids via cut-down consisting of 70 cc. of blood and the rest was 2½% glucose in ½ strength Ringers-lactate. A levine tube was passed at the time of admission and suction used throughout. The

only laboratory work done was a c.b.c. at the time of admission which showed evidence of infection but no anemia. Autopsy revealed the generalized peritonitis.

(8) I. K. was born prematurely by 1½ months and was referred to U. N. H. 3 days after birth in January, 1956 because of a quiet, distended abdomen and an absence of stools. A diagnosis of meconeum ileus and meconeum peritonitis was made via X-ray and he was operated on the day after admission. At surgery a large loop of necrotic small bowel was found and this loop was brought out of the right rectus incision, the wound was closed around it and the loop was then transected to produce a double-barreled ileostomy. The excised bowel was approximately 25 cm. long.

A cut-down was done pre-operatively and 100-150 cc. of 2½% glucose in ½ strength Ringers-lactate were given daily. He was placed on streptomycin and penicillin after surgery and pancreatin was instilled into the distal end of the enterostomy daily until the meconeum was removed on the 4th day. On the 6th post-operative day nutramagen oral feedings were begun and the cut-down discontinued. On the 9th day the ileostomy was closed with a side-to-side anastomosis. He received 40 cc. of whole blood and 40 cc. of plasma after the second surgery and oral feedings were resumed the day after the anastomosis was done. Eight days after closure he began to have small amounts of drainage from the wound that was proven to be intestinal in origin by the use of dye, but

since some dye also came out through the anus, additional surgery was not done. I obtained my information up to 7 days after the second surgery and the patient was having increasingly less drainage from the wound, was eating well, and was starting to gain a few ounces of weight. He had also been jaundiced throughout his hospital stay and this too was decreasing. Serum sodium levels taken 3 and 6 days after admission were 152 meq./L., and 136 meq./L. respectively. There is probably additional information available on this patient which I shall try to obtain as an addition to this paper.

Summary

The incidence of causes for ileostomy performed here does not agree with the other reports in that no cases of ulcerative colitis were encountered. The ulcerative colitis patient is, though, the major candidate for ileostomy in all other reported series and we have dealt with the indications for surgery, the specific technic, and the complications usually encountered with the ulcerative colitis patient in greater detail on the basis of these reports. The other indications for surgery, including congenital atresia, megacolon, meconeum ileus, volvulus, and adhesions, are dealt with in more general terms because of the greater variability in type of case. The fluid and electrolyte problems are grouped into those arising from the obstruction or from the diahrea that the diseases leading to ileostomy usually

produce. The post-operative fluid balance problems were discussed with a few generalities. All eight cases in which ileostomy was done were reviewed, but no attempt to find cases in which ileostomy might have been helpful was made.

Conclusions

The eight reported cases added to the impression provoked by the literature that ileostomy is not a single operation but several done for a variety of causes. In all of these cases ileostomy has been done because no other surgery, such as colostomy, or resection and anastomosis, was possible. It was used as an 'only hope' operation and the results have been very poor. They have been so poor that its use in more elective cases would not appear to be justified. Whenever it is used though, meticulous attention must be paid to surgical technic, including the post-operative use of catheters. The more liberal uses of serum electrolyte determination would also seem justified, especially if the newer micro-technics are available. Giving extra salt in post-operative oral feedings might be worthwhile, as might the prophalactic use of antibiotics. General supportive care is required, and the unexpected, which so frequently occurs, must be dealt with promptly.

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