ACUTE INTUSSUSCEPTION IN CHILDHOOD

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Intussusception has been recognised for over 2,000 years. Both the operative and the hydrostatic methods of reduction used today are said to have been suggested at that time by the Greeks of Cos. The first successful operative reduction was performed in this country by Sir Jonathan Hutchinson in 1871. Gross and Ware, of Boston, reported in 1948 a mortality of below 3 per cent., compared with one of 59 per cent. some 30 years ago, and some recent series, especially from large centres (Jones, Hindmarsh, Court and Jackson, 1953; Forshall and Rickham, 1953), had a mortality as low as 1 per cent. On the other hand, other recent series, especially those including the war years, show a mortality of 10 to 20 per cent.

Improvements in diagnosis and treatment continue, but there is still no general agreement as to the place of hydrostatic methods of reduction, nor of the best way to deal with the irreducible or gangrenous intussusception. The purpose of this paper is to discuss some of the clinical aspects of acute intussusception in childhood, and the treatment in particular of the irreducible intussusception.

Diagnosis

The dramatic classical clinical picture of this condition is too well known to need repetition. Morrison and Court (1948) emphasized certain points in which their Newcastle series differed from the usual textbook description. The fall in mortality in a later series (Spence and Court, 1950) was attributed to earlier diagnosis by the family doctor. Some of the clinical aspects of 100 consecutive acute intussusceptions in childhood treated by operation at the Radcliffe Infirmary, Oxford, from 1938 onwards will be considered in a similar way.

Importance of Early Diagnosis. Of these 100 children, 23 were operated upon within 12 hours of the onset of symptoms, and 29 more within 24

hours, without fatality. There were 2 deaths after 20 operations within the next 24 hours, and 5 deaths after the remaining 28 operations performed after this time.

Age and Sex. Thirty per cent. of the present series were female. Infants of three to six months accounted for 15 per cent. of the total (Table 1).

TABLE 1
AGE IN 100 CHILDREN WITH ACUTE INTUSSUSCEPTION

Age:	Months				Years		
	Under 3	3-5	6-8	9-11	1-2	3-6	7-30
Number:	1	15	26	11	34	10	3

Cause of the Intussusception. Three of the cases were due to a Meckel's diverticulum, one to an adenomatous polyp, and one to an appendix (Fig. 1) turned completely inside out (Forshall, 1953). Enlargement of the mesenteric glands is a very common finding in intussusception.

Clinical Picture in the First 24 Hours. The cardinal symptoms of pain, vomiting and the passage of blood were all present during the first 24 hours in only 40 of the present series, and 39 of the Newcastle series (Table 2).

TABLE 2
THE MAIN COMBINATION OF SYMPTOMS IN THE FIRST 24 HOURS

Clinical features	No. and per cent. of the cases
Pain, vomiting and blood	40
Pain and vomiting	25
Vomiting	9
Vomiting, blood and minimal pain ..	7
Pain and blood	7
Pain	7
Vomiting and minimal pain ..	5

Spontaneous Passage of Blood. In less than half the cases was blood passed by rectum within 12 hours of the onset, and no blood was passed at any time by 25 (although in 3 of these it was found

FIG. 1.—An appendix turned completely inside out.

on the examining finger), compared with 24 in the Newcastle series (Table 3).

TABLE 3. TIME WHEN BLOOD WAS FIRST PASSED

Time	No. and per cent.
At onset	11
Within 12 hours	38
Within 24 hours	11
After 48 hours	15
Never	25

Fever. Although it is often stated that the temperature is normal or subnormal, or that fever is a late sign, in the present series, before operation, 43 had temperatures below 99°F., 33 between 99° and 99.9°F. and 27 above 100°F. These figures are not so high as in the Newcastle series, where some rise of temperature was found the rule even on the first day of the disease, and in half of them was as high as 100 to 104°F.

Abdominal Tumour. An abdominal tumour was felt in 73 patients.

Anatomical Type of Intussusception. There was a higher proportion of small bowel intussusceptions than is usual (Table 4).

TABLE 4. ANATOMICAL TYPE

	Ileo-ileal	Ileo-ileo-colic	Boundary
No. of cases ..	6	18	76
Per cent. of deaths	27.6	4.6	4.5

Of the 6 ileo-ileal intussusceptions, 3, aged one, two and three years, involved Meckel's diverticula, 2 requiring resection with 1 death; of the remaining 3, aged four months, four and twelve years, 2 involved the middle third of the small intestine,

1 requiring resection. The clinical picture of these 6 ileo-ileal intussusceptions was characterized by pain and vomiting, but absence (4 cases) of delayed passage of blood and difficulty in feeling a tumour (1 felt by abdomen and 1 by bimanual examination under anaesthetic). The condition is said to be commoner in older children.

Recurrent Intussusception. Two children had already been operated upon for intussusception on a previous admission.

Spontaneous Reduction. Two intussusceptions were found reduced at operation, one following a barium enema and the other after palpation of the tumour under anaesthesia. It seems likely that several others, not proved by operation or radiography and not included in this series, reduced spontaneously, and that at least two of these were recurrent intussusceptions.

Chronic Intussusception

During the period under review, 3 children aged seven, seven and a half and eight years with chronic intussusceptions, were successfully treated by operation; in 2 a resection was necessary. These cases are not included in this series and have been discussed by Garvie and Kemp (1945).

Barium Enema

Although some half-dozen early cases, not included in this series, were reduced without incident during the period under review, operation has proved a satisfactory routine for these early cases, and all the children so treated in the first

TABLE 5. ANALYSIS OF THE SEVEN DEATHS

Age and sex	Duration	Type	Treatment	Time of death after operation	Probable cause of death
4 years (M.)	2nd day	Boundary	Reduction (bowel gangrenous)	2 hours	Circulatory failure.
16 months (M.)	4th day	Boundary	Exteriorization	72 hours	Pneumonia terminal event.
6 months (M.)	5th day	Boundary	Reduction	14 hours	Prolonged obstruction: hyperpyrexia terminal event.
4 months (M.)	3rd day	Ileo-ileal	Reduction	7 hours	Circulatory failure.
15 months (M.)	4th day	Ileo-ileal (Meckel's)	Resection	6 hours	Prolonged intestinal obstruction: circulatory failure.
6 months (M.)	2nd day	Boundary	Resection	4 hours	Circulatory failure.
2½ years (F.)	4th day	Ileo-ileo colic	Reduction	40 hours	Acute gastric dilatation final cause of death.

24 hours recovered. A barium enema has been used as an aid to diagnosis in difficult cases, and by some to effect partial reduction in order to facilitate the subsequent operation.

Excellent results have, of course, been obtained by hydrostatic methods, either alone or combined with operation, by Hipsley (1948) and Nelson (1949) in Australia, Lindberg and Morales (1949) and Nordentoft (1950) in Scandinavia, and Ravitch and Morgan (1952) in the United States, amongst others. In spite of these successes, as Teall (1951) says, opinion still remains sceptical in Great Britain, where the majority of paediatricians prefer surgical treatment. It is difficult to be certain that an ileo-ileal intussusception has been reduced completely, nor is a gangrenous intussusception necessarily irreducible. The purpose of this paper is not to discuss in detail the treatment of the early cases in which this method finds its use.

Irreducible or Gangrenous Intussusceptions

Six of the 122 acute intussusceptions in children operated upon at the Radcliffe Infirmary from 1938 to the early part of 1953 were found to be irreducible, and 4 others were gangrenous after reduction. Two patients seen recently, both boys of five months, are of interest. Both recovered, the first uneventfully after a short-circuit, the second following a resection made unavoidable by damage to the bowel in attempted reduction, and post-operative paralytic ileus. Resections were also performed on children aged three, four, five and twelve years of age with recovery, and in children aged six and fifteen months with a fatal outcome. An exteriorization operation was performed on a child of sixteen months who also died.

Fatal Cases

There were 7 deaths in the 122 children (Table

5); 5 deaths occurred in the first and 2 in the second half of the series. In 3 children, blood was passed before the family doctor was called, but the child was not sent into hospital until after the next visit. In 2 others the diagnosis was missed in hospital for 36 hours, possibly owing to recurrent intussusception and lack of repeated examination and barium radiography. In 3 of the 7 fatal cases the bowel was not gangrenous, and 2 of these died within 24 hours of operation. In some cases what would now be considered adequate resuscitative measures were clearly lacking.

Treatment

The routine treatment has been by operative reduction in the usual way, through a right paramedian incision. A barium enema occasionally has been used as an aid to diagnosis. General anaesthesia after passage of a gastric tube is a routine. The value of adequate preparation for operation with special attention to electrolyte balance, the availability of blood, and careful post-operative care with nasogastric suction, antibiotics and parenteral fluid where indicated, cannot be overstressed. We have no experience of glycerine as an aid to reduction (Ireland, 1950) nor of injecting streptomycin into the bowel to reduce toxic absorption (Zintel, Wiley, Nichols and Rhoads, 1947), nor of a transverse incision for this type of operation.

Removal of the appendix was performed more often than indicated solely on grounds of impaired viability of the organ, and any primary cause of the intussusception was dealt with. Wansborough and Cram (1952) condemn routine appendectomy, because of the danger of leakage from the stump, and Gross and Ware (1948) remove

any primary cause some two weeks later.

No preventive operation has been attempted.

The Irreducible or Gangrenous Intussusception

It is fortunate that reduction is easily achieved in most cases of acute intussusception. Only small series of irreducible or gangrenous intussusceptions have been published even from the larger centres, and most individual surgeons encounter this condition very occasionally. Case reports based on a single recovery still appear in the literature. In spite of the striking fall in the mortality of these cases in the last few years, it is probable that at least a quarter of these children die. It is difficult to assess the merits of the various methods of treatment unless the age and condition of the child, the type of intussusception and other details are considered. In the present series, for example, in which 10 of these cases were treated over fifteen years, the only conclusion one can draw in this respect is that no child aged two years or less recovered until the 2 recent infants already mentioned.

Incidence of Irreducible Intussusception

The incidence of 8 to 9 per cent. in this series is not unusual and the experience of Dennis (1947), who found that half his cases in Minnesota required resection, must be exceptional. McLaughlin (1948) gave the incidence as 12.4 per cent. in a large collected series, White and Dennison (1952) as 7.6 per cent., while Snyder, Kraus and Chaffin (1949) give a figure as low as 4 per cent.

Cause of Death in Untreated Cases of Intussusception

Warren Tay (Hutchinson, 1874), from post-mortem studies of 131 untreated cases of intussusception, showed that there was rarely peritonitis even when gangrene of incarcerated intestine had occurred; obstruction seemed to have been the main cause of death. Experimental work on dogs by Montgomery and Mussil (1930) supported this view, and lateral anastomosis around the unresected mass has been performed successfully on many occasions. Macnab (1948), however, implies that peritonitis is almost invariable in untreated intussusceptions. White and Dennison (1952) state that they have never seen death from peritonitis in an unresected intussusception, but the bowel may not recover after forcible reduction and the child die of ileus or peritonitis. Ravitch and McCune (1950) have cultured faecal bacteria from the outside of what appeared after reduction to be only severely congested bowel.

Spontaneous separation of an intussusception with passage of the slough occurs from time to

time, and recent reports include those of Benson, Carpenter and Swedenburg (1953), Welsh (1952) and Poltegher (1951). Louw (1949) has also given an interesting account of an African who disdained orthodox methods of treatment of acute intestinal obstruction and consulted his witch doctor. A medicine was prescribed and taken and, after an uncomfortable night, the patient passed the slough in the form of what he described as 'the father and mother of all snakes.' Recovery was rapid and complete.

Operative Techniques in the Irreducible or Gangrenous Intussusception

Much has been written on this subject lately and other recent reviews not referred to elsewhere are those of Benson and Sharpe (1950), Kahle (1951), Laurence and Ufelder (1952) and Ware and Coffey (1950).

There are now three main methods of dealing with this problem, by resection and anastomosis, by exteriorization, and by short-circuiting. The Jasset procedure, in which the intussusception is excised through an incision in its sheath, would not seem to be popular today, although Barnes described a modification in 1947.

(1) *Resection and Anastomosis.* The first successful resection in a child is credited to Clubb (1907). This procedure once had an extremely high mortality, and Tedesco (1951) considered that it was worth publishing a single recovery after resection in an infant, while McLaughlin (1948), reviewing the literature up to 1947, could find only 13 successful resections below a year. Dennis (1947) has had 8 consecutive successes using a one-layer aseptic silk anastomosis technique; his resection rate was 50 per cent. The resection mortality in Edinburgh was reduced from 100 per cent. to 10 per cent. by not persisting with attempts at reduction, but resecting before the child became shocked, and Aird (1952) reports a consecutive series of 17 resections with 13 recoveries. The 5 resections performed by Forshall and Rickham (1953) out of 106 children in Liverpool were all successful. A very long segment of proximal dilated gut was removed, and the bowel anastomosed end to end with silk mattress stitches.

(2) *Exteriorization Resection.* Gross and Ware (1948) advocate their modification of the Paul Mikulicz procedure and had 11 successes in 14 operations. They excise the extruded mass over clamps, and perform a proximal enterostomy to reduce distension. Exteriorization procedures used to carry an even higher mortality than resection and anastomosis, but the problems associated with the fistula are now better understood and more easily managed. Nevertheless,

convalescence may be protracted (Conway and Dawson, 1949). Macnab (1948) advises the Woodhall method, in which an entero-anastomosis is made at the time of resection, and subsequent crushing of the spur thus obviated. Recently, Jones (1953) and his colleagues in Newcastle have lost only 1 of 9 children on whom they performed their modification of the two-stage exteriorization procedure.

(3) *Lateral Anastomosis.* Lateral anastomosis leaving the irreducible mass untouched was first reported in 1909 by Parry and by Rutherford. More recently it has been recommended by Hamilton Bailey (1944) and by the late Professor Grey Turner (1943).

Elliot-Smith (1935) reported three successful cases. No toxic effects were noted in these, nor in two subsequent cases. In one, after commencing reduction, it was clear that a resection would be necessary if reduction was completed; the intussusception was reformed, the entering and ensheathing layers were stitched together and an ileo-transverse colostomy performed. In another, a successful short circuit was performed for an ileo-ileal intussusception. Stuppel (1939), however, after a similar operation, had to reopen the abdomen for peritonitis, and this operation is probably inadvisable in pure small bowel intussusceptions, where the tight ensheathing layer may become gangrenous. McLaughlin (1948), in his review, traced 31 short-circuit operations of this type with a mortality rate of 26.6 per cent.

White and Dennison (1952) reported from Glasgow a series of 16 infants with irreducible intussusceptions treated by ileocolostomy with 12 recoveries. If the bowel is gangrenous, they recommend exteriorization in addition, and this was done in 6 of their cases, with resection as soon as the infant was fit. They regard symptoms from toxic absorption as inevitable.

Comment

Whichever method is used, it is clear that the best results will be achieved by the experienced surgeon associated with a paediatric unit and, second, that prolonged attempts at reduction must be avoided, or the child will be too shocked to benefit from other measures. It is difficult to say how long attempts at reduction should continue. White and Dennison (1952) consider that, with experience, a very few minutes will suffice to know whether reduction will occur, while Hamman (1952) suggests ten minutes' gentle pressure. Much depends on the condition of the child. Damage to the bowel from excessive pressure will preclude a simple lateral anastomosis.

From the evidence available at the present time, while it is difficult to dogmatise as to the treatment

of the individual child with an irreducible or gangrenous intussusception, certain conclusions emerge. Resection is the most difficult and severe procedure, and probably more likely to be followed by ileus, but it gives good results in skilled hands. Exteriorization is an easier and a less shocking procedure, but convalescence is often complicated by electrolyte and nutritional disturbances. However, in recent years, transfusion during operation and a better understanding of post-operative metabolism have lessened the dangers of both these operations. Lateral anastomosis is simple and straightforward and there is little shock; it is possible that convalescence may be impeded by the effects of toxic absorption.

The infant, especially if really sick, will not stand resection as well as the simpler lateral anastomosis. There may be older children, too, in whom a resection will be fatal but a short circuit life-saving. If the outer sheath of the intussusception does not appear viable—an unusual event—then a two-stage exteriorization resection operation with ileocolostomy is less shocking than resection and obviates the loss of intestinal juices inherent in a Mikulicz-type operation.

Summary

(1) The clinical features of acute intussusception in childhood have been considered.

(2) The 7 deaths in 122 children treated by operation between 1938 and 1953 have been analyzed.

(3) The problem of the irreducible or gangrenous intussusception, especially in the sick infant, has been discussed; the short-circuit operation is recommended.

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