

artery compared to a normal appearing proximal segment was noted in excess of 1 mm. in 14.8% of all the arteries. The incidence of dilatations at various sites was plotted and found to be maximal at the exit from Hunter's canal. A microscopic comparison was made of this phenomenon at two levels in one of the cases. The average age for these cases at death was 57. Their average brachial blood pressure was 137.5/74.5.

An attempt is made to correlate various grades of atherosclerosis of the thigh arteries with the aorta. The association with hypertension and diabetes is briefly reviewed, and finally the incidence of myocardial infarction and of thrombosis of the carotids was mentioned.

### INTUSSUSCEPTION\*

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THIS STUDY covers 575 cases of intussusception at the Hospital for Sick Children, Toronto, including all cases from 1915 to October 30, 1950. These have been divided into three groups as shown in Table I with respective mortality rates for each group.

TABLE I.

	Cases	Deaths	Mortality	Cases operative	Deaths	Op. mortality
Group I (1915-29).....	236	65	27.5%	234	65	27.5%
Group II (1930-39).....	148	26	17.6%	146	24	16.4%
Group III.....	191	10	5.2%	187	8	4.2%

The significant feature is the marked fall in mortality rate in the past ten years with a current overall mortality rate of 5.2% and operative mortality rate of 4.2%.

Table II reviews the age incidence.

We can see from this: (1) Intussusception is exceedingly rare under the age of 3 months. (2) It is sufficiently common between the ages of 2 years and 14 years that we should not rule it out in our consideration of the acute abdomen. (3) There is no age group in which the mortality is disproportionately high.

The sex incidence was 367 male to 208 female, or a ratio of 1.8/1. The fact that the mortality

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rate rises with the duration of symptoms is well demonstrated in Table III.

It is quite significant that in 105 cases operated upon in the last ten years within 24 hours of the onset of symptoms, no deaths occurred. Because of this we do not attempt routine reduction by barium enema. The only cases it is successful in are early cases, and in these the surgical mortality rate in good hands, and this includes an anaesthetist experienced in infant anaesthesia, is

TABLE II.

Age	No. of cases	Percentage	Deaths
Under 3 mos.	7	1.2	1
3 mos. to 1 year.....	349	61.8	63
1 year to 2 years....	90	15.8	18
2 years to 6 years...	89	15.6	14
6 years to 14 years..	32	5.6	4
Total.....	567		101
Youngest case.....	4 days old		
Maximum incidence.....	5th month		
11 cases over 10 years of age.			

practically zero. Moreover, in enema reduction there is no real assurance that the reduction is complete.

The typical signs and symptoms of intussusception are characterized by (1) sudden onset,

(2) signs of pain (crying, writhing, drawing up legs), (3) vomiting, (4) blood in stools which is usually of mucoid or jelly-like consistency, (5) refusal of feedings, (6) mass in abdomen which is often sausage-shaped, and which, in well-advanced cases, may be palpated per rectum. The child shows signs of shock with pallor, slight cyanosis, rapid respirations and listlessness. In late cases these signs persist and to them are added the signs of intestinal obstruction and/or peritonitis. Many cases, however, will not show a typical history. The only story the mother may give is that the child will not eat, vomited once, and may have had no stool that day. Careful examination may reveal a mass, either by abdominal or rectal examination, with frequently

recurrences. Three cases recurred more than once: one twice, one three and one four times. The percentage incidence was 1.7%. Recurrences may be associated with initiating pathology (Meckel's diverticulum, bowel tumour, etc.) not removed at first operation. All these recurrences were late, that is several weeks or months postoperatively. Recurrences in the immediate postoperative period do not occur.

Reduction without operation was accomplished in 12 cases, 4 reduced with diagnostic enema. Eight at operation were found to have œdema in the ileo-cæcal region indicating spontaneous reduction. Meckel's diverticulum was recorded in 25 out of 566 cases operated upon and in most of these formed the apex of either an

TABLE III.

Duration of symptoms	Entire series (1916-1950)			Current series (1940-1950)		
	No. of cases	Deaths	Mortality	No. of cases	Deaths	Mortality
Under 24 hours	262	10	3.8	105	0	0
Under 48 hours	123	21	17.0	38	1	2.6
Under 72 hours	75	25	33.0	26	1	3.8
Over 72 hours	88	43	49.0	31	8	25.8

TABLE IV.

Type	Ileocæcal	Ileocolic	Ileal	Colic	Compound	Multiple	Chronic
Cases	343	90	35	8	24	4	2
% incidence	67.6	17.8	6.94	1.6	4.7	0.78	0.39
Mortality	41	18	9	0	5	0	0
% mortality	11.9	20.0	25.7	0	28.3	0	0

In addition there was one reported case of intussusception of ileum into a patent vitello-intestinal duct.

blood on the examining finger. If there is doubt there should be no hesitation in giving a barium enema. There is another group of atypical cases that we have seen fairly frequently. Many fatal cases came into hospital with an apparent gastro-enteritis, and were treated as such until too late. Whether these are primarily cases of intussusception with incomplete obstruction and diarrhoea, or cases of gastro-enteritis that develop an intussusception due to hyperperistalsis we cannot say.

An analysis of the incidence of symptoms showed 90% with vomiting, 87% with sudden onset, 85% with bleeding, 84% with mass, 96% with either bleeding or mass.

The incidence of recurrence was 10 cases out of the 575, seven of which were single recur-

ileo-ileal or ileo-colic intussusception. If one is found it should be removed.

The incidence of various types of intussusception is recorded in Table IV.

The ileocæcal type is the commonest. Of the three types, ileocæcal, ileocolic and ileal, the ileocolic and ileal have a much higher mortality rate. A feature seen at operation in many of the ileocæcal intussusceptions is a small persistent dimple on the anterior superior aspect of the terminal inch of ileum. This is seen and persists after reduction.

Routine appendectomy with operative reduction of the intussusception is condemned. Two cases in this series came to autopsy having died from peritonitis due to a leak through an appendiceal stump. If appendectomy seems necessary due to gangrene of the appendix a silk

intestinal purse string suture should be used reinforcing the inverted area with two or three Lembert type of silk sutures.

The most gratifying feature about all bowel surgery in the last ten years has been the striking reduction in mortality rates. This is well seen in cases of intussusception that required resection. In Group I cases (1915-29) there were 26 resections, only 3 of which were successful. The resection mortality rate in this group was 88.5%.

In Tables V and VI the resections for Group II (1930-39) and Group III (1940-50) are considered.

TABLE V.

RESECTIONS 1930 - 1939			
Type	No. of cases	Cured	Died
Exteriorization.....	1		1
Ileum (side-side).....	1		1
(end-end).....	4	1	3
Ileum (undetermined)....	1		1
Ileo-ascending.....	3		3
Ileo-transverse.....	1	1	
Total.....	11	2	9
Mortality rate 81.8%.			

Indications for resection are (1) Inability to reduce the intussusception; (2) Gangrene of the bowel wall; (3) Perforation of the bowel; (4) Bowel tumour (rare).

In Group III (1940-1950) there were 15 cases resected, and 2 cases where the bowel was exteriorized because the patient's condition did

TABLE VI.

RESECTIONS 1940 - 1950			
Type	No. of cases	Cured	Died
Maunsell.....	1	1	
Exteriorization (ileo-colic)	3	1	2 (see above)
(ileum).....	2	2	
Ileum (end-end).....	4	4	
(side-side).....	2	1	1
Ileo-transverse (side-side)	2	2	
(undetermined).....	1	1	
Ileo-colic (where in colon not determined).....	1	1	
Ileo-ascending.....	1		1
Total.....	17	13	4
Mortality rate 23.5%.			

not permit of further operative procedure. Both of these died.

From the above reviews of resections in the three groups it is apparent that the most successful types of resection and anastomosis are the

ileal and the ileo-transverse. In the entire series there is no record of a successful one stage ileo-ascending resection and anastomosis. The Mikulicz type of two stage exteriorization procedure has been successful in three cases, one of which was an ileo-ascending anastomosis. It has been unsuccessful in two others in the last ten years but these were cases where the patients were in an almost moribund state and exteriorization was performed as the least traumatic procedure. There would not seem to be any particular advantage in the Mikulicz type of procedure judging from these results alone. It is the procedure of choice where the patient's general condition is poor. In doing the ileal resection and anastomosis the ends of bowel to be anastomosed should be transected obliquely with the greater length on the mesenteric side. This allows for anastomosis with less narrowing. Ileo-transverse anastomosis may be either end-end or end-side.

An analysis of the various causes of death in Group II (1930-1939) and Group III (1940-1950) is recorded in Table VII.

TABLE VII.

CAUSES OF DEATH IN INTUSSUSCEPTION		
Cause of death	Deaths (1930-1939)	Deaths (1940-1950)
Peritonitis.....	11	3
Pneumonia.....	3	1
Shock and toxæmia.....	3	1
Toxæmia.....	7	3
Undetermined.....	2	1
Shock and peritonitis.....		1

It is readily seen that the chief causes of death are peritonitis, toxæmia and pneumonia. In short, bacterial infection has been the chief cause of death, if we consider toxæmia as at least partially bacterial in origin.

Now, why has the mortality rate been so markedly lowered in the last ten years? Some have attributed it to improved standardization of operative technique. Gross and Ware in their review of 610 cases attribute their recently improved results to using the two-stage Mikulicz type of procedure. This obviously is not a factor here. The introduction of the Wangensteen suction and later the Miller-Abbott tube with continued suction to decrease pre- and post-operative distension is the most important factor responsible for improvement in mortality figures.

The Wangensteen suction and the Miller-Abbott tube did not come into common use in this hospital until 1939, as far as the treatment of intussusception was concerned. Previous to that drainage was obtained by gravity methods or intermittent aspiration by syringe. A better understanding of supportive therapy including blood transfusions, intravenous glucose, and saline has accounted for some of the improvement in mortality figures, but these factors seem to have been well appreciated in both the Group II (1930-1939) series and the Group III (1940-1950) series. They were less well understood in the Group I (1915-1929) series. Perforations, which were formerly treated by ileostomy or suture, are now considered an indication for resection. Standardization of technique with the discontinuance of anastomosis of ileum to ascending colon is of some importance.

The improvement in early diagnosis, in the last ten years 59% of cases in the first 24 hours, compared with 42% in all previous years, has helped to lower the mortality rate to some extent, and we can better treat and prevent pneumonia and streptococcal septicæmia, which complicated these cases in the earlier years of this series.

In addition to the above factors, the improved mortality rate in the past ten years has been influenced by the introduction of chemotherapy. The sulfa groups and later penicillin and streptomycin were used. In the Group III resections they were used in nearly all the cases surviving, actually in 11 out of 13. Of the four resections that died, two were simple exteriorization procedures performed on moribund patients, one was an ileo-ascending resection and anastomosis in which sulfathiazole was started postoperatively, and the last one was a resection of ileum with side-to-side anastomosis and in this case there was no chemotherapy until shortly before death, which was 24 hours postoperative. It would seem to be advisable from the clinical evidence above and from work on the experimental animal to give perhaps both penicillin and sulfa drugs to cases of well advanced intestinal obstruction, and to commence these on admission. They will combat toxæmia and will reduce ulceration and inflammation in the intestinal wall, and thereby promote healing of the anastomosis and prevent peritonitis.

#### SUMMARY

575 cases of intussusception have been reviewed, with an overall mortality rate in the period from 1940 to October 30, 1950, of 5.2%, which is a marked reduction compared with the mortality rates of 27.5% for the 1915 to 1929 period, and 17.6% for the 1930 to 1939 period. The mortality rate for resections has also been reduced in the last ten years from over 80 to 23.5%. The various factors responsible for this reduced mortality rate have been discussed and the most important are considered to be the introduction of continuous intestinal suction, maintaining fluid balance, and the introduction of chemotherapy. It is suggested that the mortality rate can be further reduced by using ileo-ileo anastomosis or ileo-transverse anastomosis in resections.

We have also shown that: (1) Intussusception is very rare under the age of three months. (2) There is no mortality in cases operated upon within 24 hours. (3) It is the physician's duty to exclude intussusception in any infant who refuses to eat or vomits over a period of several hours. Rectal blood or mass in the abdomen in such an infant should be sought for. The presence of diarrhoea does not exclude intussusception. (4) Older children with signs of intestinal obstruction may have an intussusception. It is commoner in older children than in infants under 3 months of age. (5) Intussusception should be considered in any infant that passes blood by rectum.

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The important points in the therapy of empyema in childhood are: early institution of adequate antibiotic therapy; repeated thorough evacuations of the affected pleural space by aspiration; and supportive measures, including transfusions, oxygen and maintenance of nutrition. If these measures are applied early, the percent of patients with empyema necessitating surgical drainage can be lowered and a satisfactory outcome may be expected in a large proportion. If trial with these methods in infections caused by antibiotic sensitive organisms does not yield satisfactory response within 2 weeks, consideration must then be given to surgical drainage.—J. A. Doucett, *U.S. Armed Forces Med. J.*, 1: 1419, 1950.