

Duodenal Ulcer in Children

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Robb, J. D. A., Thomas, P. S., Orszulok, J., and Odling-Smee, G. W. (1972). *Archives of Disease in Childhood*, 47, 688. **Duodenal ulcer in children.** Forty-nine cases of duodenal ulcer in children are presented. Strict radiological and clinical criteria were observed in making this diagnosis. The children came from a population of approximately 100,000 children over a 10-year period. Upper abdominal pain was the commonest presenting symptom, and exacerbations and remissions of the disease were observed to be shorter than is expected in the adult. Haemorrhage occurred as a complication in 24% and there were no cases of perforation or stenosis. A family history of duodenal ulcer was found to be highly significant, and it was found that in 55% of patients there was an important element of stress.

Treatment was conservative in all but 2 cases, in both of which a vagotomy and pyloroplasty were performed. These operations were judged to have been successful. 6 cases had appendicectomy in the hope of relieving undiagnosed abdominal pain, in which it was unsuccessful. A plea is made for keeping this diagnosis in mind when dealing with abdominal pain in children.

Hospital physicians as well as family doctors are often slow to consider a diagnosis of duodenal ulcer in children. This is not surprising as the condition is uncommon even in the practice of those interested in it. Though Theile (1919) found 219 cases in the literature, Proctor (1925) could find only 2 examples among the records of 8,260 patients with peptic ulcer seen at the Mayo Clinic. Guthrie (1942) described 9 cases in 6,059 necropsy examinations at Glasgow Children's Hospital, 1914-41.

Goldberg (1957), reporting a series of 20 cases, noted a suspicious yearly increase but concluded that 'those who seek shall find'. Milliken (1965) in Dublin, and Habbick, Melrose, and Grant (1968) in Glasgow believe that the increase in childhood duodenal ulceration is real. This is also the view of Fällström and Reinand (1961).

Material and Methods

One hundred and twenty patients with peptic ulcer symptoms have been extensively investigated. These presented at two Belfast children's hospitals during the decade 1961-70. A firm diagnosis of duodenal ulcer was made in 49. All were under age 13 years at the time of diagnosis. The majority were screened by one radiologist (P.S.T.) and the x-rays of the remainder have been scrutinized by him.

Criteria for diagnosis. In those cases not coming to surgery or necropsy, diagnosis was made by barium meal examination. Demonstration of an ulcer crater or the presence of unequivocal deformity of the duodenal cap were the criteria for diagnosis. Patients with only indirect signs such as spasm, irritability, or duodenitis have not been included in the ulcer group. If two or more barium meals on the same patient yielded different radiological results, cases were classified as ulcers if they fulfilled the diagnostic criteria in one of them. In 3 cases a barium meal was not undertaken, the diagnosis was made at necropsy in 2 and at laparotomy in 1 (Table I).

TABLE I

Method of Diagnosis in 49 Cases of Duodenal Ulcer

Method of Diagnosis	Total
Laparotomy	1
Necropsy	2
Barium meal—crater	33
deformity	13
Total	49

This paper presents data on 49 ulcer patients and also includes the results of acid studies from 30 of the other 71 patients investigated.

Mothers and children were carefully questioned about the symptoms of most concern to the child. These have been classified under two main headings—principal presenting symptoms and additional symptoms.

CHANGE OF STATUS

NO CHANGE (5)	DEFORMITY (2) CRATER (3)					
	INDIRECT SIGNS	DEFORMITY	CRATER	DEFORMITY	INDIRECT	NIL
CHANGE (23)	1 → 4		1 → 1	9 →		
	5 →			3 →		

FIG. 1.—Children with a duodenal ulcer who had more than one barium meal.

Family pedigree was recorded; relatives were only accepted as having an ulcer if barium meal or surgery confirmed its presence.

The incidence of emotional stress was investigated. Particular care was taken to uncover emotional problems in an atmosphere of relaxed co-operation. The interview never took place before the second, and rarely before the third, attendance at the clinic; it was abandoned if adequate rapport was not established. The aim was to obtain communication in depth without self-consciousness. Questions covered many aspects of home and school life including the emotional relationship of the parents to each other and to their children.

Gastric acid output under basal conditions and after stimulation with pentagastrin (dosage 6 µg/kg) was carried out on 30 cases with duodenal ulcers. 30 of the non-ulcer group who had presented with a dyspeptic history were also tested. All who were submitted to this test were fasted overnight, and children under 13 years old were admitted to hospital on the evening before the test. Next morning a No. 10 nasogastric Levin tube was passed and, by x-ray screening, the tip of the tube was placed in the most dependent part of the stomach. All the tests were conducted by the same senior research nurse who was also responsible for the titrations.

Results

Radiology. Of the 49 cases diagnosis was made by barium meal in 46 (Table I). Two or more barium meal examinations were carried out in 28. Of these there was no change in the radiological findings in 5. In 10 the ulcer status became worse, and in 13 there was evidence of improvement (Fig. 1).

Sex. Of the 49 patients with proven duodenal ulcer, 37 were male and 12 were female, a ratio of 3 : 1.

The age of onset of symptoms for both sexes is indicated in Fig. 2. 9 children developed symptoms during the first 5 years of life. 3 of these were neonates, 2 being diagnosed at necropsy in cases of

exomphalos and hydrocephalus, respectively, and one child, thought to have pyloric stenosis, was diagnosed at laparotomy.

Seventeen children developed symptoms between the ages of 5 and 8 years, and 23 were between the ages of 9 and 12 when they first complained. When first interviewed by us, 12 of the ulcer group were over 13 years of age.

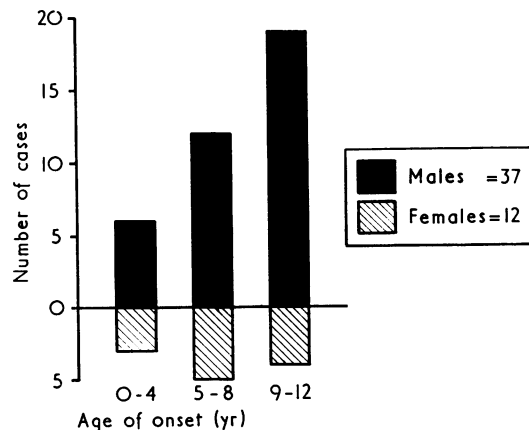


FIG. 2.—Incidence by age of onset and sex of 49 cases of duodenal ulcer 0 to 12 years.

Average duration of symptoms before diagnosis. This is shown in Fig. 3. It is exceptionally long in the 0 to 4 age group and around 2 years for the remainder.

Symptoms. The two symptoms of most concern in each case have been termed the *principal presenting symptoms*. These have been subdivided into the main symptom and the second symptom (Fig. 4). Other less important symptoms have been classified as *additional symptoms* (Table II).

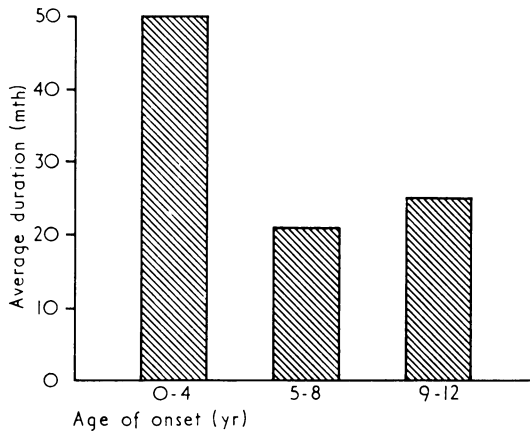


FIG. 3.—Average duration of symptoms before diagnosis in 49 children with duodenal ulcer.

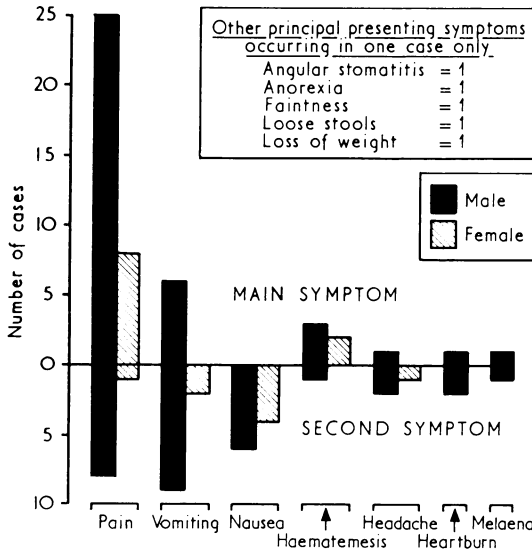


FIG. 4.—Principal presenting symptoms in 49 children with a duodenal ulcer.

TABLE II

Additional Symptoms (Dyspepsia) in Children with Duodenal Ulcer

	Male	Female	Total
Heartburn alone	15	1	16
Waterbrash alone	13	2	15
Flatulence alone	10	0	10
Combination	27	0	27

Note: Total heartburn, 38; total waterbrash, 35; total flatulence, 27.

Pain. Upper abdominal pain was by far the commonest complaint. The pain was situated in the umbilical region in 7 (67%) of the girls and 15 (41%) of the boys. In all except one of the remainder it was sited in the epigastrium. As a main symptom it occurred with similar frequency in both sexes—25 male and 8 female (68 and 67%, respectively). In addition it was the second symptom in a further 9 cases.

The duration of exacerbations was less than one week in 30 children: in 17 of these it lasted only one day (Fig. 5). It persisted for two weeks or more in

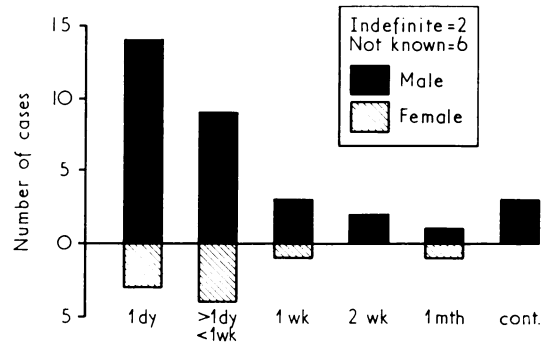


FIG. 5.—Usual duration of painful syndrome in 49 children with a duodenal ulcer.

only 7 cases. In 8 cases reliable information could not be obtained. The period of remissions was less than one month in 37, greater than one month in only 5. In 7 cases reliable information could not be obtained. While a fairly clear picture emerges of short exacerbations and short remissions, it is not possible to detect any particular pattern in the bouts of pain experienced during the exacerbations. Fig. 6 shows that the numbers complaining of pains lasting less than a half hour equalled those with pains lasting between one-half and two hours. The circles indicate the number in whom the bouts of pain occurred 'once', 'two or three times', and

< 1/2 hour	1/2-2 hours	>2 hours	not known
19	19	3	8

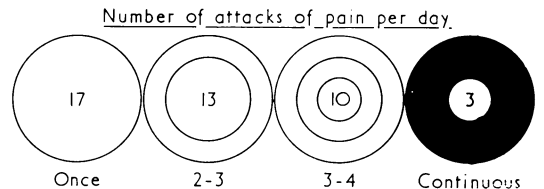


FIG. 6.—Pattern and frequency of pain in 49 children with a duodenal ulcer.

'three or four times' per day. 3 complained of 'continuous' pain.

In only 12 cases was the pain relieved by eating. 17 noted that eating aggravated the pain and no effect was recorded in 15. 17 complained of night pain and in 3 cases, all male, this was the most common time for the pain.

Nausea and vomiting. Nausea was in no case a main symptom but was recorded as the second most important symptom in 10 cases (Fig. 4). Vomiting was a principal presenting symptom in 17. It was an additional symptom in a further 11. Table III

TABLE III
Vomiting in Children with Duodenal Ulcer

	0 to 4 (9)	5 to 8 (17)	9 to 12 (23)	Total
Related to eating	3	7	6	16
Not related to eating	6	1	5	12
No effect on pain	6	2	5	13
Relieved pain	1	6	3	10
Aggravated pain	0	0	2	2
Not relevant	2	0	1	3

Note: Males, 23; females, 5; total, 28.

shows its relation to both eating and pain. It occurred immediately after eating in 16. In only 10 did it relieve coexisting pain.

In the youngest age group vomiting was the commonest main symptom occurring in 4 (67%) (Table IV).

TABLE IV
Principal Presenting Symptoms in Children with Duodenal Ulcer 0 to 4 Age Group

Symptom	Main	Second
Pain	1	3
Vomiting	4	1
Nausea	0	1
Haematemesis	1	0
Nil	0	1

Bleeding. There were 6 cases of haematemesis in 2 of which melaena was not documented. 7 cases of melaena were documented but in only 2 was it a principal presenting symptom (Fig. 4). Occult blood examination of the faeces, which was carried out on all cases, was positive in 10, in 3 of which there had been no history of haematemesis or melaena. There were therefore 12 patients who had evidence of bleeding.

Bowel habit was on average once per day and regular in 37, less than once per day in 6, and greater than once per day in 4.

Heartburn was a principal presenting symptom in only 3 cases but figured prominently among additional symptoms (Table II). This table also shows the very high incidence of 'dyspepsia' which was particularly prevalent in males.

Headache was a principal presenting symptom in 4 children; it was also mentioned by some as an additional symptom.

Presentation in youngest group. In the 0 to 4 years age group the principal presenting symptoms of the 6 children diagnosed by barium meal are summarized in Table IV. Only one presented with bleeding. There were no cases of perforation. Vomiting was the commonest main symptom.

Family history. Table V compares the percentage of fathers, mothers, and grandparents with peptic ulcers in three groups of local children (Dodge, 1970) with those of 46 of this duodenal ulcer group. There is a significant increase in the incidence among fathers and mothers in the ulcer group ($P < 0.001$). The incidence among fathers is very high indeed. The difference in incidence among grandparents of the ulcer group and grandparents of the control groups is without significance ($0.05 < P < 0.1$).

Blood group. In Table VI blood groups obtained in 44 of the duodenal ulcer cases are compared with those of three groups taken from the

TABLE V
Incidence of Peptic ulcer in Parents and Grandparents

Relative %	282 Unselected Patients (Dodge, 1970)			Present Series
	Tonsillectomy	Matched Controls for Children with P.S.	Random Selection School Clinics	Children with Duodenal Ulcer
	62	101	119	46
Fathers	9.7	6.0	6.7	32.6
Mothers	0	0	1.7	8.7
Grandparents	4.9	4.2	4.4	10.2

TABLE VI

Blood Groups Percentages in Population at Large Compared with Those in Children with Duodenal Ulcer

Blood Groups	Tonsil Controls	Kopeč (1970)	Macafee (1964)	Children with Duodenal Ulcer
	1495	27,757	11,000	44
O	48.09	55.01	48.75	68.2
A	38.32	33.03	37.01	15.9
B	10.51	9.45	10.85	13.7
AB	3.08	2.51	3.39	2.3

Northern Ireland population. There is a significant increase in blood group O among the duodenal ulcers compared with the incidence in tonsil controls (Dodge, 1967) and in blood donors in the same population (Macafee, 1964) ($P < 0.01$). On the other hand, in comparison with Kopeč's (1970) figures, the increased incidence of blood group O among children with duodenal ulcer is without significance ($0.05 < P < 0.1$).

Emotional stress. No control groups have been studied by us in response to questions concerning emotional stress. Nevertheless, the findings summarized in Table VII suggest a high incidence of stress in the emotional background of these patients. Satisfactory interviews were achieved in 28 male and 10 female patients. Of these, 17 (61%) males and 5 (50%) females were living in a stress situation.

TABLE VII

Emotional Stress in Children with a Duodenal Ulcer

	Males (28)	Females (10)
Home	10	2
School	6	2
Combination	1	1
None apparent	11	5
Not noted	9	2

Note: Emotional stress prominent in 17 males, 5 females.

Gastric acidity. Graphs comparing the results for the ulcer and non-ulcer groups are shown in Fig. 7. In the two groups basal acid output, maximal acid output, and peak acid output have been plotted against weight. The difference between the two groups is not statistically significant in any of the comparisons. Nor was there any difference of statistical significance for similar comparisons by age in years. The maximal acid output in mEq HCl/10 kg per hr was calculated. The mean for

the ulcer group was 3.30 and for the nonulcer group 3.50.

Treatment. In only 34 of these patients did the children adhere to the treatment advocated. 28 were prescribed a combination of diet and antacid; 15 of these claimed improvement. Of 3 treated by antispasmodics one claimed improvement, and of 3 treated with metoclopramide (Maxolon) all claimed improvement.

Surgery was used in two cases. In both, vagotomy and pyloroplasty were carried out. In one, a boy of 12, the indication for surgery was intractable pain; in the second, a boy of 14, severe haematemesis. The former has had no pain since his operation and now, aged 22, weighs 93 kg. An insulin test meal carried out 10 years after operation suggests that the vagotomy was incomplete. In the latter, bleeding was controlled and at follow-up a year later the child had gained 3.2 kg in weight and had had no recurrence of symptoms. 6 cases had had appendectomy. Appendicitis was confirmed in only 2; in the remainder the operation had been done in the hope of alleviating undiagnosed abdominal pain. In this respect none had had his pain relieved.

Discussion

Reports of duodenal ulcer in children have become more frequent in recent years (Tudor, 1967). Wider paediatric care and easier access to radiological facilities make it difficult to assess if this increase is one of incidence or diagnosis.

With improvements in radiological equipment and, in particular, with the development of the image intensifier, radiological examination of the stomach and duodenum in children has become easier. Awareness that a duodenal ulcer crater may frequently be present without significant deformity (Stein *et al.*, 1964), and that an ulcer crater may only fill momentarily with barium in the presence of duodenal irritation (Alexander, 1951), makes it important that meticulous care is taken in observing and showing the pyloroduodenal region during a barium meal examination. More than one barium meal may be required for a firm diagnosis (Trufanov, 1967). Ravitch (1969) advocates at least two satisfactory examinations before accepting a negative report, a view supported by Goldberg (1957). This is particularly pertinent in view of the incidence of change in the radiological status of the duodenum, an aspect of the disease which we would stress (Fig. 1) and which has been described elsewhere (Ravitch and Duremdes, 1970). In the series of Habbick

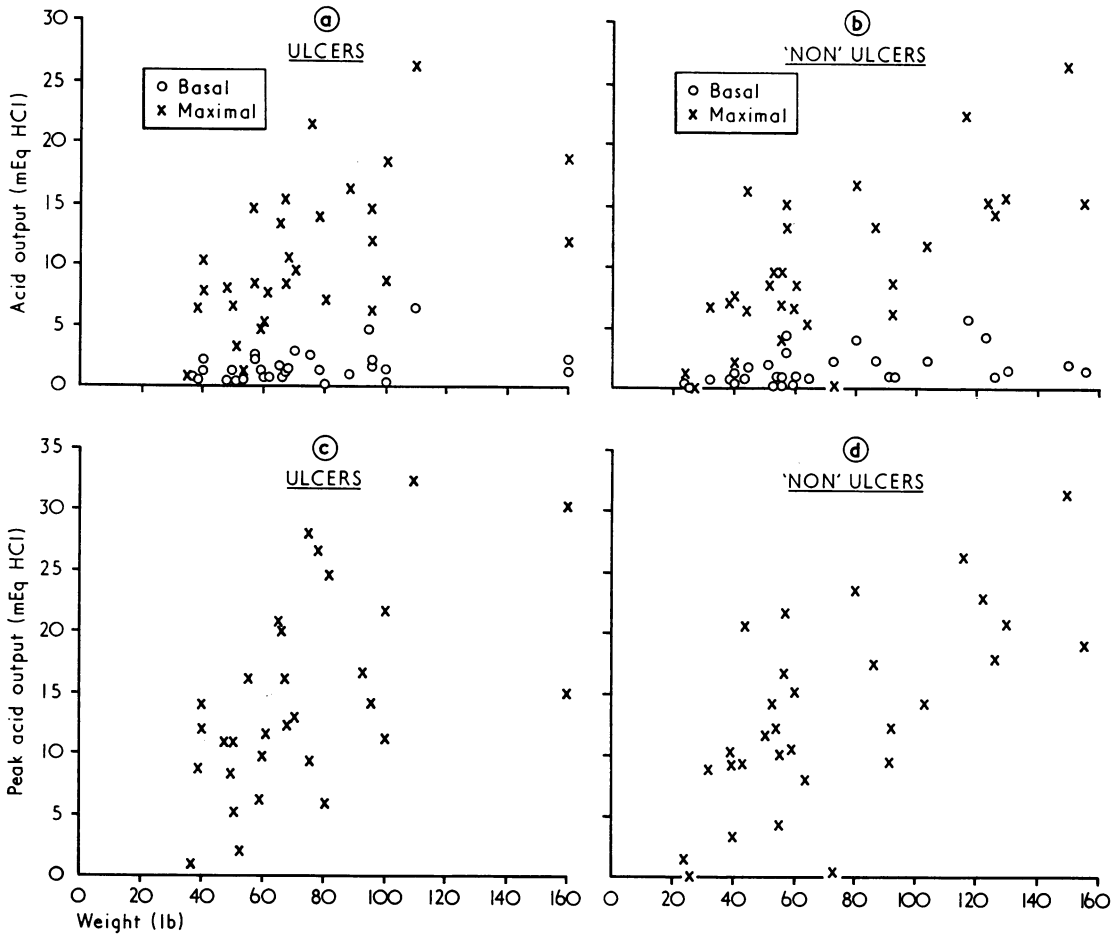


FIG. 7.—Comparison of the acid production with the weight in 49 children with a duodenal ulcer (ulcer group) and in 30 children with dyspeptic symptoms but no ulcer ('non' ulcer group).

et al. (1968) x-ray diagnosis was made on the appearance of a crater only. We have extended this to include unequivocal bulbar deformity. In 109 cases of duodenal ulcer in infants and children seen at the Mayo Clinic from 1930 to 1958, a crater or deformity on barium meal was a criterion for diagnosis (Michener, Kennedy, and Dushane, 1960).

Indirect radiological signs on screening, such as irritability, spasm, delay in emptying, or tender cap, are accepted as diagnostic by some, and in this respect it is well to take cognizance of the view of Trufanov (1967) that duodenitis is a forerunner of duodenal ulcer. It may be that the incidence is even higher than we have indicated. Perhaps refinement in the design and use of the fibre

duodenoscope (Oi, Takemoto, and Nakayama, 1970) may yet provide the most certain answer to the problem.

In studies of peptic ulceration in childhood, duodenal ulcer is very much more common than gastric ulcer (Guthrie, 1942; Solanke and Antia, 1968; Ravitch and Duremdes, 1970), and during this study only two cases of gastric ulcer have been seen. These are not included in the series under discussion. Duodenal ulcer is commoner in males. A ratio of 3 : 1 compares with 1.7 : 1 (Dogan *et al.*, 1969), 3.5 : 1 (Rosenlund and Koop, 1970), and 3.5 : 1 in Indian children (Singh and Ghai, 1969). Solanke and Antia (1968) found a similar ratio in Nigerian children.

In very young infants, reports of duodenal ulcers

are well documented. In this series, of the 9 cases under 5 years of age 3 presented in the neonatal period. 2 of these were incidental necropsy findings in association with exomphalos and hydrocephalus, respectively. The association with disease of the central nervous system was recognized by Cushing (1932). In the third neonate a duodenal ulcer was found at laparotomy after a diagnosis of pyloric stenosis. A possible relation between these two conditions has been postulated by Dodge (1970). Only one of the preschool children presented with bleeding; there were no cases of perforation. This does not agree with the findings of others (Raffensperger, Condon, and Greengard, 1966; Ravitch, 1969; Rosenlund and Koop, 1970). In contrast to the suggestion of van Benthem and Tan Wen Hian (1969) and the *Lancet* (1968), the symptomatology of the older groups was not similar to that of the adult. No patient in this series was referred from the Burns Unit, though an incidence of Curling's duodenal ulcer of 0.49% in 1,197 burns is reported by Kopecký and Kalina (1969).

Of particular interest has been the rhythm of short exacerbations and short remissions of the painful syndrome. On the other hand the pattern of the pains is not clear. Approximately equal numbers were of less than half and more than one-half hour's duration. The number of attacks per day varied considerably.

Night pain as a feature has been stressed by Goldberg (1957), Fällström and Reinand (1961), and Milliken (1965), and 17 of the present group suffered from it.

Bleeding was discovered in 12 cases. The proportion of haematemesis, melaena, and positive occult bloods was similar to that described by Fällström and Reinand (1961) in a study of 36 patients.

In this series there was no case of either pyloric stenosis or perforation. Both are rare, particularly the former. Habbick *et al.* (1968) reported one case of pyloric stenosis treated by partial gastrectomy in which growth and nutrition were subsequently normal. Two cases of perforation have been reported from the Mater Infirmorium Hospital, Belfast (C. J. Gilligan, personal communication, 1970). These both occurred in the same week in children about to sit their 11-plus examination. The perforations were oversewn and the patients have since been well. Kon and Syrnikov (1968) emphasized that in young people the results of closure were dependent on the duration of the previous history and the degree of induration at the time of operation. An interesting case of two

duodenal ulcers perforating simultaneously is reported by Zudov (1968).

Contrary to expectation, bowel habit was usually regular. In only 10 was the admitted habit other than once per day. The appended bibliography makes no comment about this. The regularity of bowel habit seemed all the more surprising in view of the high incidence of dyspepsia. This, too, does not seem to have been fully documented in many other studies. There were 19 cases of dyspepsia in the series of 36 of Fällström and Reinand (1961).

The considerable delay in diagnosis is not surprising, and the longer period in the lower age group has been the subject of comment elsewhere (Dogan *et al.*, 1969). The exceptionally long delay of 50 months for those who developed symptoms in the 0 to 4 years age group may have been due to the difficulty of ensuring that the onset described by the mother was not a manifestation of some other infant illness. A delay of around two years has been shown for the series as a whole. Family doctors unaware of the possibility of duodenal ulcer are slow in referring the child who usually appears well. Receiving hospitals are unlikely to be of much help unless aware of the possibility. Suspect children should be carefully reviewed and where any suspicion is entertained barium meal should be requested (Raffensperger *et al.*, 1966).

Attention has been drawn by Fällström and Reinand (1961), Habbick *et al.* (1968), and Dogan *et al.* (1969) to the influence of family history. The significant increase in fathers and mothers with peptic ulcers is confirmation of this. There was a very high incidence of peptic ulceration among fathers (32.6%).

The high incidence of blood group O in adult duodenal ulcer is well known (Aird *et al.*, 1954). This has also been the subject of comment in studies on the childhood disease (Fällström and Reinand, 1961; Dogan *et al.*, 1969; Habbick *et al.*, 1968; Dodge, 1970). Our figures show a significantly increased incidence of blood group O among children with duodenal ulcer when compared with control groups of Macafee (1964) and Dodge (1970). Compared with figures provided in a personal communication by Kopeć to Dodge (1970) the increase in blood group O among the duodenal ulcer group is without significance.

Though no controls have been studied with regard to emotional stress, the incidence of 58% in those having a satisfactory interview suggests that this is an important factor in aetiology in children, a viewpoint shared by others (Cwiklicka, 1969; Ravitch and Duremdes, 1970).

Pentagastrin tests were carried out by a similar

method to that used by Lari, Lister, and Duthie (1968). Similar work has been done using histamine (Ghai *et al.*, 1965; Habbick *et al.*, 1968; Kopel and Barbero, 1967). The results of maximal stimulation by pentagastrin 6 µg/kg and histamine 24 µg/kg have already been compared in adults (Emås, Lilja, and Borg, 1969) and found to give similar results. Pentagastrin stimulation has been carried out on 30 of the ulcer cases and on 30 of those referred who were not subsequently placed in the ulcer group. In agreement with the results of Ghai *et al.* (1965) both maximal acid output and peak acid output increased with age and weight but differences between the ulcer and non-ulcer group for both age and weight were without significance.

Acidity tests seem to be of much less significance than in the adult (Dogan *et al.*, 1969). The maximal acid output in mEq HC1/10 kg per hr varies slightly in different reports, being 2.02 (Ghai *et al.*, 1965), 2.39 to 2.62 (Kopel and Barbero, 1967), 2.18 (Rødbrø *et al.*, 1966), and 3.19 for non-ulcers, and 3.30 for ulcers (Habbick *et al.*, 1968). The mean in the present series was 3.30 for the ulcer group and 3.50 for the non-ulcer group.

Various forms of treatment used in the adult were unsatisfactory. In our series, 12 had their pain relieved by eating but 17 complained that eating aggravated it. Various combinations of antacids with diet, antispasmodics, and sedatives have not been particularly effective. Relief of symptoms is dependent on many factors which makes evaluation of drug therapy difficult. Provision of long-awaited diagnosis, relief of anxiety, and a natural tendency to change status undoubtedly play a role. Some will inevitably get better and some, regardless of therapy, will continue to have symptoms in adult life. Michener *et al.* (1960) found that 50% of those children followed up into adult life had retained their duodenal ulcer.

The position of surgery is still open to debate but indications and procedures have been more clearly defined in recent years. Bird, Limper, and Mayer (1941) studied 119 cases which had come to surgery because of complications of their ulcers. The mortality rate was 11%. In 1953, McAleese and Sieber found a further 23 cases in the paediatric literature and added 4 of their own.

In the present series one boy operated on at age 12, ten years ago, now weighs 100 kg and is in all respects normal. The other has been followed up for one year after vagotomy and is well, having gained 3.2 kg in weight. For perforation, surgery is the treatment of choice and simple oversewing should be undertaken (Proscia and Sorisio, 1968). Decision with regard to haemorrhage may be

difficult. In the neonate the case for swift intervention is made by Guthorn *et al.* (1970).

For the chronic ulcer, vagotomy and pyloroplasty have largely superseded partial gastrectomy in reported cases. Johnston and Snyder (1968) described this operation in 14 cases and Schuster and Gross (1963) favour it for the critically ill but advocate vagotomy and antrectomy for the elective case. Ravitch (1969) advocates a much more aggressive approach than most authors, operating without mortality on 5 uncomplicated duodenal ulcers over a period of 2 years. He advises vagotomy and drainage as the procedure of choice (Ravitch and Duremdes, 1970). Weight gain and growth after this type of procedure have been shown in puppies to be the same as in controls (Boley *et al.*, 1965). Raffensperger *et al.* (1966) performed the operation in 7 children with apparently no ill effects.

In conclusion, it should be noted that, while duodenal ulcer is rare in children in comparison with adults, nevertheless it is not an excessively rare disease. These two hospitals serve a population of about 100,000 children and will have referred to them cases whose diagnosis is difficult or obscure, as in children with duodenal ulcers. A predominant feature of these cases is the frequency of upper abdominal pain as a presenting feature. Though duodenal ulcer may not be the commonest cause of upper abdominal pain in children, it should certainly be kept in mind when making a diagnosis. Perhaps in this way an earlier diagnosis may be made, and the child and his family relieved of a prolonged period of uncertainty, and fear of the unknown, which at the least must exacerbate the agony.

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