THE SURGICAL PROBLEM PRESENTED BY PEPTIC ULCER OF THE STOMACH AND DUODENUM IN INFANCY AND CHILDHOOD*

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While the details of the management of peptic ulceration in the adult have been the subject of a great volume of current and past medical literature, little has been written of the problems presented by this disease in early life. The last comprehensive review was presented by Bird, Limper and Mayer[4] in 1942. Since that time individual cases and small groups of cases have been reported. The relative rarity of these lesions, especially those serious enough to require surgical consultation, makes any single surgeon's personal experience in their management limited. It is, therefore, not surprising that questions arise in the course of the management of the occasional case: questions which are not answered in the readily available literature, and rarely by personal experience. The following study and review was prepared to bring these questions to the attention of others, and to assemble available information which may provide help to those facing similar problems.

Table I presents the experience at Children's Hospital of Pittsburgh from 1938 to 1951 inclusive. In addition to these 16 patients, the diagnosis of duodenal ulcer was made in 40 outpatients during the past year. The diagnosis in this last group was a radiological diagnosis; the patients did not require hospitalization, therefore these cases are not included in this report.

The incidence of 16 cases in 65,000 hospital admissions is in keeping with that recorded in the literature. It will be noted that duodenal ulceration (13 cases) was more common than gastric ulceration (3 cases). Cases were seen in all age groups. The complications of perforation and hemorrhage were more common in the younger patients, whereas pain and obstructive symptoms were more common in the older children. These are generally recognized features of this disease.

The presence of diseases associated with duodenal ulcers has received little attention, but they have been frequently noted in gastric ulceration. Serious diseases of possible etiological relationship were present in four cases of duodenal ulcer. Among these latter was one case each of the following: splenomegaly due to Banti's syndrome, congenital hydrocephalus, serious drug reaction and cystic fibrosis of the pancreas. The association of cystic fibrosis of the pancreas with fatal perforation of a duodenal ulcer verified by autopsy must be an unusual condition, since only one such case report[28] has been noted in the literature.

Associated diseases were present in each of the three cases of gastric ulceration. These were tuberculosis of the spine, brain abscess and bronchial asthma. Malnutrition, chronic diseases and cerebral lesions have been repeatedly implicated in the etiology of gastric ulceration.

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The diagnosis was made at postmortem examination in four cases, at operation in two cases and by roentgenogram in ten cases. Each autopsied case represented a diagnostic failure, since the correct diagnosis was either missed clinically or made only when the patient's condition was hopeless. In older children, diagnosis closely paralleled that in adults. In infants, however, the diagnosis was frequently obscure and occasionally impossible, until serious or fatal complications had already taken place. The following case is presented as typical of the difficulties encountered in making the diagnosis in infancy.

TABLE I.—*Summary of Cases of Peptic Ulcer at Children's Hospital, 1938 to 1951, inclusive.*

Operation	No. Cases	Indication for Surgery	Case No.	Result
Exploratory Laparotomy	2	Hemorrhage (Hematemesis and melena)	2	Asymptomatic and well 2 yrs. later.
			8	Recurrent hemorrhage 2 yrs. later.
Posterior Gastro-enterostomy	4	Obstruction	10	6 mo. later asymptomatic and well.
		Abdominal pain bleeding —Intractable symptoms.	14	Subtotal gastrectomy necessary 4 years later for hemorrhage and obstruction—(see below) asymptomatic since resection.
		Perforation and abdominal pain.	15	Marginal ulcer 6 mo. P. O.—still having "mild" symptoms.
		Obstruction and abdominal pain.	16	Marginal ulcer 9 yrs. later—now receiving medical treatment.
Anterior Gastro-enterostomy	1	Obstruction.	3	6 mo. later asymptomatic and well.
Pylorotomy	1	Obstruction.	3	(Same as case of Anterior Gastro-enterostomy).
Appendectomy	3	Abdominal pain.	6	Gastric ulcer found at autopsy.
			14	Done at same time as PGE.
			15	Done at same time as PGE.
Gastric Resections	1	Hemorrhage and obstruction.	14	Subtotal gastrectomy 4 yrs. after PGE.

CASE REPORT

Case 1.—A. P., a male infant, born February 18, 1947, after a normal 9-month gestation and normal delivery, was admitted April 9, 1947, after 5 weeks of progressively severe post-prandial emesis. Dehydration, emaciation, mild abdominal distention, a questionable right upper quadrant mass and crying on palpation of the right upper quadrant were noted on examination at admission. An initial diagnosis of pyloric stenosis with malnutrition was made. The infant improved rapidly with antispasmodics and dietary management, and on April 18, 1947, was sent to the convalescent section of the hospital. He was returned to Children's Hospital 4 days later because of emesis, green watery diarrhea and abdominal distention, which had developed gradually over a 2-day period. Examination at this time showed a critically ill infant with marked abdominal distention and excoriation of the buttocks. Roentgenogram examination showed free air in the peritoneal cavity. Fecal vomiting quickly developed, and while the diagnosis of generalized peritonitis secondary to perforated viscus was obvious at this time, the infant was in terminal condition. He died on April 28, 1947, his sixth hospital day. At autopsy there was found an 0.5 cm. perforation in the first portion of the duodenum at its posterior inferior border and a generalized peritonitis.

The roentgenogram examination is of much value, not only in confirming the diagnosis, but in following the results of treatment. In a recent summary of the place of the roentgenogram in diagnosis and management of these cases, Alexander[1] reported 30 cases of peptic ulcer. These were found in a series of 254 children examined for gastro-intestinal symptoms in routine and general hospital roentgenologic practice over a 5-year period. A high index of suspicion and an increase in the number of gastro-intestinal roentgenogram examinations in children should bring about increasingly frequent diagnosis of this condition in its more benign phase.

According to therapy, these cases may be divided into those receiving no treatment, those treated medically and those treated surgically. The cases coming to autopsy had no definitive treatment. Seven patients were operated upon and 5 of these had procedures directed toward permanent

TABLE II.—*Summary of Cases Undergoing Surgery for Peptic Ulcer Symptoms at Children's Hospital of Pittsburgh, 1938 to 1951 Inclusive.*

Case No.	Sex	Age At Time Of Diagnosis	Location Of Ulcer	Presenting Symptom	Diagnosis By	Treatment	Result
1	M	6 wks.	Duodenal	Perforation	Autopsy 4-28-47	None	Died 4-28-47.
2	M	13 mo.	Duodenal	Hematemesis	Expl. Lap. 5-8-50	Medical	Asymptomatic 2 yr. P. O.
3	M	16 mo.	Gastric	Emesis pallor	X-ray 5-22-51	Pylorotomy—6-2-51 PGE —6-4-51	Well—9 mo. P. O.
4	F	3 yr.	Duodenal	Hematemesis	X-ray 9-15-39	Medical	Not followed.
5	F	3 yr.	Duodenal	Perforation	Autopsy 1-11-51	None	Died 1-11-51.
6	M	5 yr.	Gastric	Abdominal pain	Autopsy 12-31-40	Appendectomy 12-26-40	Died of H. streptococcal peritonitis 5th PO day.
7	F	6½ yr.	Gastric		Autopsy 9-14-50	None	Died 16 days following craniotomy for brain abscess.
8	F	7 yr.	Duodenal	Hematemesis	Expl. Lap. 10-14-48	Medical	Repeated hematemesis —last episode 1951.
9	F	7½ yr.	Duodenal	Emesis	X-ray 6-12-51	Medical	Well—6 mo.
10	F	9¾ yr.	Duodenal	Obstruction	X-ray 6-4-51 & Surgery	PGE 8-13-51	6 mo. post operative asymptomatic.
11	M	11 yr.	Duodenal	Abdominal pain	X-ray 3-25-39	Medical (Marsh drip of aluminum hydroxide)	4-10-38 Ulcer healed by x-ray. 6-5-39 Recurrence. Asymptomatic in 1951.
12	F	11 yr.	Duodenal	Abdominal pain	X-ray 7-10-51	Medical	Well—6 mo.
13	M	12 yr.	Duodenal	Abdominal pain	X-ray 7-1-40	Medical (Appendectomy 9-1-39)	Severe symptoms until 1947. Asymptomatic 1951.
14	M	13 yr.	Duodenal	Abdominal pain Bleeding-emesis	X-ray 12-17-43 & Surgery	PGE & Appendectomy 12-17-43	1-6-48 Subtotal Gastrectomy for bleeding and obstruction. Asymptomatic to 2-22-52.
15	M	14 yr.	Duodenal	Perforation 4-19-44 Abdominal pain	X-ray 5-3-44 & Surgery	PGE 5-10-44 & Appendectomy	Marginal ulcer 6 mo. P. O. Now under treatment.
16	M	14 yr.	Duodenal	Obstruction & Pain	X-ray 3-11-39 & Surgery	PGE 4-26-39	1938—Marginal ulcer treated medically. At present on medical therapy.

cure of the ulcer. The current status of each patient is recorded in Table I, and the experience with those treated surgically is summarized in Table II.

The following case is considered of sufficient interest to merit inclusion as a separate case report.

Case 2.—L. H., a 16-month-old boy, was admitted to Children's Hospital on May 17, 1951, because of vomiting and bronchial asthma. The child's developmental history showed no variation from the normal except for the onset of bronchial asthma at 8 weeks of age. Three weeks prior to admission the child had an attack of bronchial asthma which lasted 3 days. This responded to medication, but diarrhea to the extent of 4 liquid black stools daily, then developed. Intermittent asthma, emesis and diarrhea persisted up to the time of admission. There was no bile in the vomitus. Examination on admission was not significant except for pallor and dehydration. He was given only parenteral feedings.

Barium studies of the upper gastro-intestinal tract showed severe pylorospasm and marked delay in emptying. On May 22, 1951, a repeat gastro-intestinal study showed delayed emptying of the stomach with the pyloric channel never widening adequately. On a third roentgenogram examination, a constant crater-like deformity of the greater curvature just proximal to the pyloric

antrum was noted. The diagnosis of gastric ulcer with partial pyloric obstruction was made. Surgery was advised and an exploratory laparotomy was done on June 1, 1951. Induration and stenosis of the pylorus was found. The child was in critical condition; therefore, a pyloromyotomy was done with the hope of relieving the pyloric obstruction. Obstruction persisted postoperatively. On June 4, 1951, the child was again operated upon. The ulcer was more easily located on the greater curvature of the stomach, and an anterior gastro-enterostomy was done proximal to the ulcer. After a stormy initial course which included initial obstruction of the efferent loop, probably due to edema, the anastomosis began to function well, allowing the child to improve rapidly.

Follow-up examination 18 months later showed the child to be developing normally and to be free of gastro-intestinal complaints.

DISCUSSION

In view of the varying opinion concerning the incidence of peptic ulceration in early life, a few words are in order. It has been the roentgenologist[1] who has called attention to the frequency of this lesion and urged more general use of gastro-intestinal roentgenogram examination in children. Upon reviewing the literature, one is impressed by the great variation in the cases of peptic ulceration in children. Some roentgenologists report duodenal ulcer only when a niche is demonstrable, others when signs of duodenitis without a niche are present. Among the autopsy reports[2, 17, 41] frank ulceration with perforation and hemorrhage are reported, but less definite and less severe cases with superficial erosion and puckered areas of absent Brunner's glands are also reported. Obviously, the rigidity of the criteria for diagnosis and the diligence with which this condition is looked for in the autopsy room and in the roentgenographic department will influence the reported incidence. Certainly peptic ulcers of the duodenum or stomach in infants and children, with complications requiring surgical consultation, are unusual. Gross,[16] Potts[35] and Donovan[11, 12] have commented on the rarity of the disease severe enough to require operation. One might well ask if this is the same disease as is found in the adult. From this study, it is our impression that in infancy, this is an acute disease with no definite etiology, frequently associated with other diseases and characterized by rapidly developing pathological changes showing

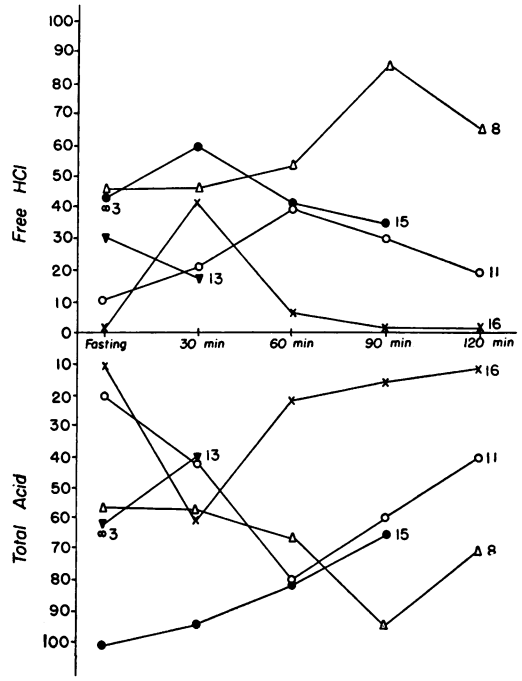

FIG. 1.—Gastric analysis in six cases of peptic ulcer in children.

no tendency to repair. It is difficult to ascribe a psychogenic origin to these cases. In the older children who comprise most of the cases, this condition is the same disease as seen in the adult, and in all probability its incidence is as great if all cases, severe, mild and recurrent, are included.

Table III is a brief resumé of the available reported cases since the complete report by Bird, Limper and Mayer in 1942.

In this review certain practical questions remain unanswered. One is impressed by the few patients followed into adult life and by the lack of information on the eventual prognosis, as well as on the effects of various forms of treatment on this prognosis. To consolidate our experience and

that of others, the following problems are presented as they occurred to us.

1. *Of what significance is the gastric analysis?*

Evaluation of the significance of the gastric analysis and gastric acidity in the etiology and the diagnosis of peptic ulceration in children is complicated by obstacles. The technical difficulties of the procedure in this age group and the lack of uniformity in presenting the results of this test are outstanding problems. Furthermore, since this condition is relatively unusual in childhood and its diagnosis frequently obscure, and since patients usually present themselves as emergencies requiring treatment, there is no time for observation. Normal values for gastric acidity in infancy and childhood have been given by various observers, but variation of the normal is great and the values for acidity in the first year of life are controversial. For these reasons, the gastric analysis is of little practical value in the diagnosis of this entity. The same difficulties are present in evaluating the gastric acidity in the etiology of peptic ulcer. In Figure 1 are graphically represented the results of gastric analysis in six cases of peptic ulcer in this series.

TABLE III.—*Summary of Cases of Peptic Ulcer in Children Reported in the Available Literature Since 1942.*

I. Duodenal ulcer		100 cases
1. Reported as autopsy finding[2, 3, 11, 13, 14, 15, 17, 27, 28, 30, 41]		31
2. Living when reported		69
Total		100 cases
3. Cases having surgery.	No.	Deaths
Appendectomy[42]	4	0
Pyloromyotomy[3, 8]	2	2
Exploratory Laparotomy[15, 21]	2	2
Gastro-enterostomy[11, 12, 16, 17, 43]	6	1
Closure of perforation[11, 22, 39]	4	0
Pyloroplasty[11]	1	0
Excision of Bleeding Ulcer[34]	2	0
Gastrectomy[22]	1	0
Ligature of Bleeding Point[35]	1	0
Total	23	5
II. Gastric ulcers		15 cases
		No. Cases
1. Reported as autopsy finging[8, 9, 11, 17, 33, 37, 41, 45]		9
A. Under 6 months	7	
Age 22 months	1	
B. Surgery (Pyloromyotomy)[8]	1	
2. Living when reported. All treated medically [11, 20, 23, 24, 29, 31]		6
Total		15 cases

Using the tables of values for free acid in normal children as prepared by Vanzart, Alvarez, Beckman and Eusterman[44] as normals, three of these children had a definite elevation of gastric acidity. One of these three children had a gastric ulcer. Of the remaining three, two had what might be interpreted as a tendency to high values and one had definite hypo-acidity. These figures are from so small a series as to be of no value statistically, but they do indicate that the hyperacidity factor may not be nearly as important as in the adult.

2. *How is perforation best handled?*

It is well established that a perforated duodenal or gastric ulcer is a surgical emergency and requires operative closure. The validity of this dictum has recently been challenged by some who claim comparable results with continuous gastric suction and general supportive therapy. That this treatment suffices in many cases in the adult is true, but one cannot subscribe to this radical departure from an established, safe management by surgery in children whose peritoneal defenses are notoriously so poorly developed. It is with some apology that Case No. 15 is referred to, in which a minimal perforation was treated in a conservative manner. One similar case[19] in a nine-year-old girl has been reported in the literature.

The technical method of closure of the perforation is important. Ladd and Gross[25] warn against purse string suturing and direct approximation of the orifice edges. Omental plugging of the opening by well-placed sutures is recommended. This

method prevents later stenosis and obstruction of the duodenum. Schwarz and Halberstein[39] report the case of an 11-month-old child with a perforated ulcer in which the critical condition of the child required speed. The perforation was closed by a purse string suture. There was no clinical obstruction on follow-up study, but stenosis was noted on roentgenogram examination.

3. *How is hemorrhage best managed?*

In general, hematemesis and melena in this age group are most commonly due to gastro-intestinal polypi or to a Meckel's diverticulum. It is not unusual, however, for the surgeon to find, upon opening the abdomen, that neither of these conditions is present, but rather, as in one of the cases (Case 12) here reported, that the bleeding is due to peptic ulceration.

In considering surgical intervention for gastro-intestinal hemorrhage as a complication of peptic ulceration, two major decisions must be made. These are, first, when is operation indicated, and second, what procedure should be followed.

Bleeding is recognized as a prominent feature of these ulcers, but its importance from the standpoint of prognosis varies. Collected autopsy series[2, 17, 41] show that death from these ulcers is usually preceded by hematemesis or melena. Protocols commonly report sudden profuse hematemesis and death within a few hours, preceded by a day or two of black stools. Perforation is commonly accompanied by, or preceded by, clinically detectible bleeding. Contrary to these findings, many case reports[11, 15, 29, 31, 32] are recorded in which hematemesis was successfully managed by conservative measures. Table IV was prepared from a survey of available data in the literature. It shows results in 24 cases of peptic ulceration in this age group where severe bleeding occurred. It is significant that only two cases of massive bleeding from peptic ulcer in children under one year of age followed by recovery have been reported. These children were treated surgically.

From this survey we conclude that some cases of severe bleeding can be successfully managed conservatively, but that a high percentage of such cases will require either additional treatment or operation at a later age. It is the unusual case in which surgery has been thought necessary for control of hemorrhage. Gross[16] has never had occasion to operate for bleeding. Potts[35] has had to operate upon only one such case.

TABLE IV.—*Result in 24 Cases of Peptic Ulcer in Infants and Children Where Serious Hemorrhage Was Present.*

Total Cases 24	Gastric Ulcers 2	Duodenal Ulcers 22
		No. of Cases
I. Non-Surgical Management		
A. Died[2, 14, 27, 28, 30]		7
B. Survived[11, 15, 29, 31, 32] (incompletely followed)		5
C. Survived but required surgery later[11, 26]		5
Total		17
II Surgery	No. of Cases	Survived
A. Bleeding site located		
1. Ulcer resected[34]	2	2
2. Ligated[38]	1	1
B. Bleeding site not located		
1. Exploratory Laparotomy[15, 21]	2	0
2. Gastro-enterostomy[17]	1	0
C. Associated with perforation		
1. Perforation closed[39]	1	1
Total	7	4

The decision to operate in these children is a difficult one. No rules have been advanced to cover this problem as have been advanced in adults, and the most acute surgical judgment is necessary in accepting these cases for operation. It is our impression that severe gastro-intestinal hemorrhage that does not respond to adequate transfusions and supportive therapy within 24 hours is an indication for surgical exploration.

Most of these ulcers are on the posterior wall of the duodenum and they may not be visible even at autopsy[21] until the intestine is opened. Such ulcers are easily overlooked at operation. To avoid this hap-

pening, careful methodical search, which may include duodenotomy or gastrotomy and direct visualization of the duodenal mucosa, is advocated. When the ulcer is found and implicated as to the source of hemorrhage, the procedure to follow must be individualized. Local excision[34] or control of bleeding point by suture ligature[35] have both been used successfully. Any more radical procedure such as gastro-enterostomy or gastrectomy seems unwise.

4. *What should be done for the cases of intractable symptomatology and obstruction?*

Authorities in pediatric surgery today caution against radical surgery, especially gastrectomy, and advocate gastro-enterostomy in these cases. While such advice comes from excellent sources, one must question the basis for such recommendations. In our review of the literature, long-term follow-ups have been few. When recorded,[40] they are presented to show the complications of gastro-enterostomy performed in childhood. Current studies are in progress to evaluate more carefully gastro-enterostomy performed during infancy and childhood and will be reported in a later communication.

Vagotomy hardly deserves comment other than to condemn its use in children. Its place in the adult with peptic ulcer is questionable. When one considers that one of its common disagreeable side effects is diarrhea, which is poorly tolerated even by older children, it is reasonable to conclude that this procedure has no place in the therapy of ulcer in childhood and infancy.

SUMMARY

1. Three cases of gastric ulcer and 13 cases of duodenal ulcer seen at the Children's Hospital of Pittsburgh over a 14-year period are presented and discussed.

2. The three cases of gastric ulcer all had associated diseases: tuberculosis of the spine, brain abscess and bronchial asthma.

3. Four cases of duodenal ulcer had associated diseases: splenomegaly due to Banti's syndrome, congenital hydrocephalus, serious drug reaction and cystic fibrosis of the pancreas.

4. All pediatric age groups are represented in the series.

5. Gastric analyses seem of little value in the diagnosis of peptic ulcer in childhood.

6. Diagnosis was made at postmortem examination in four cases, at operation in two cases and by roentgenogram in ten cases.

7. Five patients had a posterior gastro-enterostomy in an attempt to cure their ulcers. Two remained well for a follow-up period of nine to 18 months. Two developed marginal ulcers. One required a subtotal gastrectomy because of obstruction and hemorrhage four years after the original operation.

8. Four patients, without definitive surgery, died.

9. Perforation of peptic ulcers in childhood is a surgical emergency and requires operative closure.

10. Hemorrhage can often be managed conservatively, but a high percentage of cases will later require additional treatment.

11. Gastro-enterostomy may not be the best procedure to relieve intractable symptoms and obstruction in children.

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