PEPTIC ULCER IN INFANCY AND CHILDHOOD WITH A REVIEW OF THE LITERATURE

BY

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The occurrence of peptic ulcer in infancy was described over a hundred years ago by Cruveilhier (1829–35) in his '*Anatomie Pathologique du Corps Humain*'. He records the presence of multiple gastric ulcers in three infants at the respective ages of one, two, and four weeks. The lesions are clearly illustrated by drawings. Since then reports on peptic ulcers in children have appeared in ever-increasing numbers in the literature (chiefly continental and American), Theile (1919a) having collected 248 cases under the age of sixteen, while Bird, Limper and Mayer (quoted Ladd and Gross, 1941) review 243 cases up to the age of fifteen. In this country, however, according to Paterson, only three British cases were published prior to 1922. In view of this dearth a series of such cases is here reported in order to draw attention to the condition, since the first essential for the diagnosis of peptic ulceration in childhood is recognition of the fact that it actually does occur, even in the neonatal period. Theile, who saw it from the first day of life onwards, considers that it almost always arises after birth, and this is confirmed by Ballantyne (1902) in his '*Textbook of Antenatal Pathology*'. Some authors, however, believe that the lesion may be present at birth. According to Ladd and Gross it has been described in stillborn infants. It is well known that acute peptic ulcers can develop very quickly, having been seen as early as nineteen hours after a severe burn (Hurst and Stewart, 1929).

It is possible that in newborn infants with a very delicate gastro-intestinal wall ulceration may progress still more rapidly: hence an intrauterine origin for ulcers need not be assumed even in infants dying shortly after birth.

Clinical material

The cases to be described, nine in number, all came to autopsy in the Glasgow Royal Hospital for Sick Children, between the years 1914 and 1941, and are included in a series of 6059 post-mortems on children under the age of thirteen. Most of the subjects coming to necropsy in this institution are infants, approximately two-thirds of those examined during the last ten-year period having been under the age of one year.

Case 1 of the series is described below in some detail, as the clinical and pathological features are typical. The post-mortem examination was per-

formed by the writer and the interest it aroused prompted a search through the autopsy records of the hospital when the other eight were forthcoming. These are relegated to an appendix.

Case 1, H. L., female, aged ten weeks, born after a normal full-time pregnancy, was admitted on December 22, 1940. She had been well until December 17 when vomiting and green diarrhoea began. Breast milk had been given for one month, afterwards diluted cow's milk. On admission the child was well-nourished, but anaemic and collapsed. The abdomen was lax. No improvement resulted and on December 24 bright red blood was passed per rectum for the first time. Copious rectal haemorrhages recurred despite administration of vitamin K and blood transfusion. The child died on December 26. At autopsy an ulcer measuring 1.25 by 1.5 cm. was present on the posterior duodenal wall just beyond the pylorus. It was terraced at the deeper pyloric end. In the base was an eroded vessel, the source of the blood which filled the stomach and bowel. The ulcer was firmly adherent to the underlying pancreas and the tear seen in the specimen was probably produced on separating the adhesions. The thoracic and abdominal viscera, the peritoneal and other serous sacs were free from gross morbid change, and the brain was normal. Double otitis media was present. On histological examination it was found that the ulcer had eroded all coats of the bowel so that the base was formed by pancreas. No inflammatory reaction had occurred, the lesion being purely destructive. There was no sign of haemorrhage, old or recent. No organisms were seen in Gram-stained sections. Several large arterioles were present in the vicinity of the ulcer base.

Age and sex incidence of peptic ulcer in childhood

Four of the patients were male, five female. Sex distribution appears to be approximately equal in early life, as Theile also found. All our subjects were under the age of twelve months except a girl six years old in whom the ulcer was in all probability traumatic in origin and is therefore in a special category. The infantile cases will be considered together. Six of these were under the age of three months, the youngest having survived only for three days.

The occurrence of peptic ulceration in early infancy is amply confirmed by others. Holt (1913) states that of sixty-five patients with duodenal ulcer 70 per cent. died before the fifth month of life, nine actually within the neonatal period. Of Theile's series one-third succumbed in the first month of life. More recent single reports of neonatal deaths from peptic ulcer are also extant. Butka (1927), Nixon and Fraser (1928), Somerford (1930), Brockington and Lightwood (1932), Dunham and Shelton (1934), Craig (1934), Kunstadter and Gettelman (1936) all publish cases fatal in the first fortnight. Craig's case, a premature infant born six weeks before term, survived only thirty-four hours. Kunstadter and Gettelman's report concerns an infant, also premature, who succumbed on the fourth day of life. A successful operation on a thirty-four-and-a-half-hour-old baby with a perforated duodenal ulcer is recorded by Bird, Limper and Mayer (Ladd and Gross, 1941).

Etiology of ulceration

Circulatory disturbance. Peptic ulceration in neonatal life has been attributed to circulatory disturbance of the gastro-intestinal tract at the time of

birth especially in prolonged or difficult labour. Either asphyxia with consequent duodenal congestion and possibly mucosal haemorrhage, or ischaemia resulting reflexly from vascular spasm, may lead to devitalization of the mucous membrane with subsequent peptic digestion of the damaged area. Irritation of the vasomotor centres in the brain as a result of cerebral haemorrhage may also affect the duodenal circulation. Further, the mechanical factor of pressure comes into play at times, according to Aschoff (quoted by Pfaundler and Schlossmann, 1935), who describes anaemia of the duodenum resulting from compression of that structure between liver and head of pancreas during birth. With the post-partum influx of blood mucosal haemorrhage is liable to occur, followed by digestion of the blood-infiltrated area. The importance of a normal blood-supply in maintaining the integrity of the duodenal mucosa is confirmed by Theile who states that any serious disturbance of circulation may be the starting point of a duodenal ulcer.

That the gastric juice even in early infancy possesses considerable powers of peptic digestion is demonstrated by the work of Miller (1941) who found that its acidity is surprisingly high, reaching a maximum within forty-eight hours of birth when it is equivalent to that of a healthy adult; thereafter it falls rapidly and remains low during infancy. This high gastric acidity would appear per se to be an important factor in inducing peptic ulceration at an early age.

Trauma. Trauma as well as circulatory disturbance may damage the gastro-intestinal mucosa in the newborn. Instruments introduced for the purpose of clearing the trachea at birth may enter the stomach and abrade the mucosa as in the case reported by Kunstadter and Gettelman (1936). These authors also saw multiple gastric erosions associated with congenital duodenal stenosis, and they attribute mucosal injury to hyperperistalsis and vomiting induced by the attempt to empty the stomach. Burdick (1940) also describes a duodenal ulcer in a three-week-old mongol with a congenital obstruction at the duodeno-jejunal junction. In a case of the present series mucosal irritation and subsequent ulceration may fairly be attributed to excessive dosage with oleum ricini in the first two weeks of life. Gastric ulcers caused by swallowing caustic fluid are reported in two young children by Hurst and Stewart (1929). Of course, irritation of the gastro-intestinal mucosa may also result from unsuitable feeding in early as in later infancy.

Sepsis. Sepsis plays a part in the production of peptic ulcer both in the neonatal period and later; a type of sepsis peculiar to early infancy is umbilical infection, of which Dunham and Shelton (1934) describe an instance. Here, staphylococcal omphalitis was followed by septic thrombosis of the umbilical vein, with resulting septicaemia, leading finally to ulceration of the gastric mucosa. As with increasing age conditions approximate more closely to those in adults, sepsis comes to play a more prominent etiological rôle in peptic ulceration. Numerous reports demonstrate the association between diverse septic lesions and gastro-duodenal ulcers in infants and children. Hurst and Stewart state regarding the part played by bacteria in the production of ulcer, 'It is clear that the gastric lesion is caused by bacterial toxins. These may be produced locally by organisms situated in the small vessels of the gastric

mucous membrane to which they have been conveyed by the blood stream or they may be produced in the primary site of the disease from which they are carried by the blood to be excreted by the gastric mucous membrane.' Of five children under the age of three years in whom gastric ulcers were found by these authors, three died respectively of meningococcal meningitis, empyema and coeliac disease.

Theile (1919a), Brüning and Schwalbe (1913) and others found duodenal ulcers associated with suppurative appendicitis. Borland (1903) saw one in an infant with an acute exacerbation of eczema of the head and face. In the case reported by Harkins (1938) a duodenal ulcer was the sequel to a large scald which became septic. There is one type of sepsis, i.e. suppurative meningitis, which appears specially prone to induce peptic ulceration. Doubtless the nervous element plays a part here as well as the actual sepsis. Berglund (1929) saw meningitis in six out of twenty children with peptic ulceration. Webster (1938), Hartung and Warkany (1938) and Letondal (1940), all report duodenal ulcer in infants with purulent meningitis, either tuberculous or acute. Hurst and Stewart's case of gastric ulcer and associated meningococcal meningitis has been mentioned, and further examples of combined ulcer and meningitis occur in various textbooks of paediatrics. No like instance occurred in our series.

Peptic ulcers may also arise in the course of the various exanthemata and likewise in toxæmic conditions, e.g. uræmia. The etiological relationship between infection and ulcer is well illustrated in the case reported by Proctor (1925), that of a young child with a chronic duodenal ulcer, in whom repeated upper respiratory infections provoked acute exacerbations with melaena and haematemesis. John (1938) reports somewhat similar findings in the case of a boy aged six years with an indurated ulcer of duodenum.

Burns and scalds. At one time duodenal ulcer was considered a fairly frequent concomitant of burns and scalds. Thus Perry and Shaw (1893) found peptic ulcers in 3.3 per cent. of subjects suffering from burns, while the incidence of ulcer in all other types of disease was only 0.4 per cent. In more recent years the association between the two conditions appears to be less frequent, probably because fewer burns become septic, thanks to modern therapeutic methods. Of 115 subjects with burns included in 6800 autopsies investigated by Stewart (1923) only two had a peptic ulcer, one of these being a child of five years with a small ulcer of the pylorus.

Marasmus. Once the neonatal period with its special dangers is past, marasmus is generally regarded as playing a major etiological rôle in the production of ulcers in infancy (Holt, 1913; Gerdine and Helmholz, 1915; Paterson, 1922; Craig, 1934; Pfaundler and Schlossmann, 1935), though it is not always easy to decide whether marasmus is the cause or result of ulcer. It may be assumed, however, that in athreptic infants (and the same is true of those born prematurely) the gastro-intestinal mucosa tends to be thin and atrophic. Support for this belief is afforded by the work of Miller who, in the course of his investigation on gastric acidity, examined histologically a series of stomachs from infants dying in the first week of life and found that, as a general rule, the heavier the infant the better developed was the gastric mucosa.

Etiology obscure. Whilst the various factors discussed may all play an etiological rôle in peptic ulceration during infancy and childhood, this undoubtedly occurs at times without obvious cause. Birth trauma could be excluded in Craig's case of duodenal ulcer in a child born by Caesarean section. Marasmus is not invariably present, nor is there always a history of unsuitable feeding, since Berglund (1929) found peptic ulcers in eight infants exclusively or principally breast fed. Of his twenty cases five were in a good and three even in a very good state of nutrition. In seven of our nine cases there is no adequate explanation for the occurrence of the lesion. Four of these infants were moderately well-nourished, only three being marasmic. In no instance was there a history of difficult or prolonged labour. Feeding was fairly satisfactory, all the infants having been at least partially breast fed. The history is negative as regards sepsis except for a slight otitis media in one infant and nasal catarrh in another, and it is extremely doubtful whether an etiological rôle could be assigned to such trivial and banal infections. No noteworthy cerebral lesion was found in any of the seven brains examined, the slight superficial haemorrhage in one of these obviously being terminal. Of the two remaining cases ulcer was probably the result of drug irritation in one and of accident in the other.

External violence. This last case is of particular interest as it is extremely unusual to find peptic ulcer resulting from external violence. Perry and Shaw saw only two instances, both in adults, in 18,000 autopsies at Guy's Hospital. Single adult cases are also reported by Chalié and Desjacques (1923), and Hurst and Stewart respectively. The last-named authors also describe the occurrence of haemorrhages and superficial gastric erosions in cases of traumatic death, and consider that such lesions might be the starting point of ulcers should the patients survive.

Pathology of ulcers

Of the nine cases, eight were duodenal; in one instance both stomach and duodenum were involved. According to the general experience, duodenal preponderate markedly over gastric ulcers in childhood.

In Berglund's series of twenty cases, fourteen involved the duodenum, five the stomach and one both these structures. Burdick (1940) reports eight cases of peptic ulceration in a children's hospital, six duodenal and two gastric. Occasionally acute ulcers are found in other parts of the digestive tract in early life. Nixon and Fraser (1928) saw an ulcer at the cardiac orifice involving both stomach and oesophagus and they quote Henoch's neonatal case where a ring of ulceration encircled the lower end of the oesophagus. Meckel's diverticulum, according to Pfaundler and Schlossmann, may occasionally be the seat of ulcer in children, and Hurst and Stewart describe a heterotopic peptic ulcer of the lower ileum which gave rise to fatal haemorrhage in a child aged seventeen months. Rarely more than one child in a family may suffer from duodenal ulcer. Rogers (1928) reports its incidence in two consecutive infants in a family of three.

Duodenal ulcers, according to our experience and to that of others, invariably occur above the ampulla of Vater and are generally situated on the

posterior wall, the most dependent part of the bowel naturally coming into closest contact with the acid gastric contents before they are neutralized by the alkaline bile. One ulcer or more may be present. Holt found that about two-thirds of the reported ulcers were single. In the present investigation, one duodenal ulcer was present in three instances, two ulcers (one very small) occurred in a fourth, and three in two other cases. In another patient a single duodenal ulcer was combined with multiple gastric erosions, which, following the opinion of Hurst and Stewart, were regarded as superficial acute ulcers. In the final case of the series, the stomach and duodenum were not opened. The clinical diagnosis, however, based on repeated haematemeses was one of peptic ulcer. At operation a thickening which was felt beyond the pylorus was in all probability the result of a duodenal ulcer, and gastro-enterostomy was performed. The diameter of the duodenal ulcers in the present series varied up to 1.5 cm. All were acute with no appreciable thickening of the wall except in the operated case quoted above, and in one other of which the post-mortem report states 'the wall of the ulcer was firm with some apparent surrounding fibrosis'. In two instances all coats of the bowel were eroded, and the base of the ulcer was formed by the pancreas. In the two others the external coat, though adherent to pancreas, appeared to be intact and was probably torn at autopsy while separating the adhesions. In the remaining cases ulceration was more superficial and did not involve the whole thickness of the intestinal wall. No peritonitis was observed in any but the operated case where the slight recent inflammatory change found at autopsy was in all probability post-operative and not due to perforation. In four instances a fairly large eroded vessel was present in the base of the ulcer and partially clotted blood filled the stomach and bowel in three of them. Since the ulcers show no distinctive features as compared with adult lesion of similar type photographs have not been reproduced.

Histology

The ulcer was available for histological examination in three cases. Two of the ulcers had involved the whole thickness of the bowel wall with complete destruction of the muscle coats. The third was somewhat more superficial, although only the circular muscle remained intact. A striking feature in all was the absence of inflammatory reaction, the lesion being purely destructive with no attempt at repair. The microscopic appearances therefore support the view that such ulcers can develop rapidly and prove fatal before there is time for the occurrence of any noteworthy cellular reaction. There was no evidence of haemorrhage, old or recent, in any instance. Several fairly large arterioles were present in the immediate vicinity of the ulcer base in one case. Erosion of such a vessel could have given rise to severe haemorrhage. Gram-stained sections in each instance were examined for the presence of organisms with negative result. Other writers, like the author, are struck by the absence of any inflammatory reaction in these acute ulcers (Paterson, 1922; Selinger, 1932; Craig, 1934; Harkins, 1938; and others).

Clinical findings

Clinically haemorrhage from the stomach or bowel is generally considered the most important and characteristic sign of peptic ulceration in infancy, when symptoms, according to Burdick, are not typical as in adults. The characteristic 'hunger-pain' is said not to occur before adolescence as a rule, nor can deep epigastric tenderness be elicited. Holt found that about one-third of the recorded ulcer cases were symptom-free during life, the lesion being discovered at autopsy in infants with marasmus or intercurrent disease. In a second group death occurred suddenly in collapse, sometimes preceded by ordinary gastro-enteritis. In this type of case autopsy sometimes showed concealed intestinal haemorrhage, death having occurred before the actual passage of blood. In a third group the ulcer perforated and led to peritonitis.

Six patients of the present series gave a clue to the presence of ulcer during life by haematemesis or melaena. Haemorrhage was severe in four, moderate in one and slight in one. In the other three there was nothing in the clinical picture to suggest the presence of peptic ulcer. In one of the latter there had been persistent vomiting and marasmus and the child died after several convulsions. In a second the condition appeared to be ordinary gastro-enteritis. The third, who was admitted on account of an irreducible inguinal hernia, collapsed suddenly and died. The prognosis of peptic ulcer in infancy is poor owing to the frequency of gross haemorrhage which is ill-borne. Rarely, however, such ulcers appear to heal spontaneously; thus Gerdine and Helmholtz (1915) saw an ulcer practically healed in an infant aged three months, and in Harrison's case quoted above, though the presence of peritonitis indicated perforation, the duodenal ulcer had actually closed.

Complications

Complications such as haemorrhage and peritonitis, appear from the literature to be fairly common in infants, probably on account of their delicate gastro-intestinal wall. Perforation is reported by Craig in a baby aged six days. Finny (1908-09), Somerford (1930), and Harrison (1931) saw peritonitis associated with perforated duodenal ulcer in slightly older infants, and Firmin-Edwards (1941) describes the rupture of a gastric ulcer with escape of stomach contents in a child of six months with hepatic cirrhosis. Peritonitis is generally afebrile since the duodenal contents are normally sterile and inflammation of the peritoneum is due to mechanical irritation rather than to infection.

Differential diagnosis

In the past severe neonatal intestinal haemorrhage has generally been attributed to melaena neonatorum, a term signifying generalized capillary oozing from a mucosa showing no gross defect. In such cases, however, careful post-mortem examination might sometimes have revealed ulceration. Hurst (Price, 1941) states that acute duodenal ulcer is the most common cause of melaena neonatorum. With this opinion we are unable to agree, as in this hospital many instances of copious intestinal haemorrhage have been seen

although gross ulceration of the gastro-intestinal tract has been excluded by careful search in such cases.

Should peptic ulcer cause spasm of the pylorus, hypertrophic pyloric stenosis may be simulated, and several cases of this type have been reported (Finny). In the case recorded by Brockington and Lightwood the passage of barium through the pylorus was delayed in an infant with a peptic ulcer. Holt thinks the association of pyloric spasm and duodenal ulcer too frequent to be accidental. The occurrence of haematemesis or melaena in a young infant whose condition is otherwise suggestive of pyloric stenosis should suggest the possibility of peptic ulcer. In diagnosis other causes of intestinal haemorrhage such as intussusception, colitis, rectal polyps must also be taken into account.

Chronic peptic ulcers in children

Though the vast majority of peptic ulcers in children are acute, chronic ulcers being extremely rare before puberty according to Hurst and Stewart, a few verified cases of the latter are recorded. Paus (1926–27) saw a chronic lesion in two children aged respectively nine and fourteen years, each with a long history of digestive trouble. Theile (1919b) reports a chronic ulcer verified at operation in a child at the early age of two years, as well as two further examples in adolescents aged thirteen and fifteen. Jankelson (1932) adds three further cases with characteristic x-ray findings, two at twelve years, the third at ten. Proctor's case of indurated ulcer with repeated acute exacerbations has already been mentioned. Such proved instances of chronic ulcer originating in childhood, sometimes even in the first few years of life, are of particular interest in view of the fact that some adults with peptic ulcer date their symptoms back to early childhood. Proctor, at the Mayo Clinic, traced the records of 1000 patients with gastric and 1000 with duodenal ulcer. Among the former sixteen, and among the latter twenty-six, had symptoms dating back to childhood. Henderson (1930–31) and Hurst and Stewart also quote adult cases with symptoms of digestive disturbance of many years' duration. More recently confirmation of early onset of some peptic ulcers has been afforded in the course of mass investigation of young soldiers with dyspepsia (Tidy and others, 1941). Judging from the scanty records of chronic ulcer in children, the results of operation are good (Theile, Paus). Jankelson's cases improved with dieting. Malignant change does not appear to have been described in juvenile ulcers.

Summary

From our own and others' findings it is evident that peptic ulceration is a well authenticated though rare disease of infancy and childhood, occurring at all ages from the first day of life onward. The youngest patient in the present series died at the age of three days. All the present cases with one exception were infants under the age of six months, and it is common experience that the majority of infantile peptic ulcers occur in the early weeks of life. Such ulcers are believed to originate after birth. The delicacy of the gastro-intestinal wall

in the new-born probably suffices to explain their rapid development. Distribution is approximately equal in both sexes. The present nine examples are included among 6059 autopsies (incidence 0.14 per cent.), approximately two-thirds of which were on children under the age of one year. On comparing these figures with those of others in child populations of approximately similar age distribution, Holt's in the Babies' Hospital, New York, most closely approach the Glasgow series. He found four duodenal ulcers in 1800 autopsies (0.22 per cent.). Paterson saw two examples among 566 post-mortems at Great Ormond Street, but mentions that no single case had occurred there in the previous twenty years. Berglund's incidence (1.55 per cent.) in Stockholm is considerably higher than our own, twenty peptic ulcers including one of tuberculous nature occurring in his series of 1323 autopsies. Frequency may vary according to locality, or if there are at times small epidemics of such ulcers associated with infection (Gerdine and Helmholtz), distribution from year to year would tend to be uneven. Certain circumstances incidental to birth and early infancy are invoked to explain the frequency of peptic ulcer at this age. Thus it is believed that circulatory instability especially in prolonged labour tends to devitalize the duodenal mucosa, any damaged area then being liable to digestion by the gastric juice, which, according to Miller, has a remarkably high acidity in the first forty-eight hours of life. Direct trauma to the gastric mucosa may occur accidentally during resuscitation at birth, whilst congestion and possibly haemorrhage may result from hyperperistalsis associated with congenital duodenal stenosis. Further, umbilical sepsis may play an etiological rôle in the newborn. In early as in later infancy, mucosal irritation may be produced by drugs or by unsuitable feeding. In babies past the neonatal period marasmus is the condition most frequently associated with peptic ulcer. Here the gastro-intestinal mucosa is probably thin and atrophic and hence less resistant than usual to the digestive action of the gastric juice. Divers types of infection may lead to ulceration. Meningitis would appear to be of particular importance in this respect. Sometimes there is no apparent etiological factor, as in the majority of the present cases (seven). Of the other two external violence was considered responsible in one, and drug irritation in the other. Eight of the ulcers in the present series were duodenal, one gastro-duodenal. The preponderance of duodenal over gastric ulcers in childhood is confirmed in the literature. Parts of the gastro-intestinal tract other than the stomach and duodenum are rarely affected, ulcer then originating in islets of heterotopic mucosa.

Duodenal ulcers in our experience and in that of others occur almost exclusively above the ampulla of Vater on the posterior wall. They are generally single though at times two or more may be present. They do not generally greatly exceed 1 cm. in diameter and may be much smaller. The ulcer in several of our cases had eroded all coats of the intestine so that the base was formed of pancreatic tissue. In four instances a large eroded vessel was present in the base of the ulcer and in three of these the stomach and bowel were filled with blood. No peritonitis was observed in any of the present cases, though this appears to be a fairly frequent complication especially in infants.

On histological examination of such acute ulcers the lesion as a rule is purely destructive, the absence of a cellular response suggesting a rapidly fatal evolution before the defence mechanism has time to come into play.

Clinically haemorrhage from stomach or bowel is the most characteristic sign of peptic ulceration in young children in whom 'hunger-pain' and epigastric tenderness are generally absent. In six of the present nine cases haematemesis or melaena had occurred during life. Haemorrhage may be the initial feature, or it may be preceded by dyspepsia. Again, the child may collapse in the course of an apparently simple gastro-enteritis and die from concealed haemorrhage, or the lesion may remain clinically latent till perforation and peritonitis supervene. In the absence of haemorrhage, ulcer is generally unsuspected, as in three of the present cases.

Duodenal ulcer may at times cause spasm of the pylorus when the condition may suggest hypertrophic pyloric stenosis. In an infant with symptoms otherwise characteristic of the latter condition haemorrhage from the stomach or bowel should suggest the likelihood of peptic ulcer. Not only acute but even chronic indurated ulcers have been recorded in children. The fact that some adults with peptic ulcer can trace their symptoms back for many years confirms the possibility of juvenile onset. Wide recognition of the possibility that chronic ulcers may arise in childhood is greatly to be desired in order that prompt relief may be afforded by suitable treatment.

Summary of case histories

Case 2, M. P., female, aged three days, was born after a normal, full-time pregnancy on July 26, 1930 (hour of birth not stated) and was admitted on July 28 with the history of having been well till 3 p.m. on that day when haematemesis and melaena occurred. The haemorrhage recurred in hospital despite intraperitoneal injections of blood, and the infant died at 6 a.m. on July 29. The disease, therefore, first manifested itself about forty-eight hours after birth. At autopsy, the stomach showed multiple small sharply-defined circular erosions and contained abundant blood-clot. In addition a terraced duodenal ulcer with an eroded artery in the base was present about $\frac{1}{4}$ inch beyond the pylorus. The whole bowel was filled with blood clot. The abdominal and thoracic viscera were free from disease. The head was not examined.

Case 3, W. E., male, aged seventeen weeks, was admitted on August 18, 1927, sunken and depleted with a history of vomiting and fever of ten days' duration. He was born after a normal, full-time pregnancy and appeared healthy. Breast milk had been given for one month, thereafter diluted cow's milk. On August 22 bright red blood was passed per rectum on several occasions. Death occurred on the following day. At autopsy the slightly dilated stomach contained 'coffee-ground' material. In the first part of the duodenum was a small ulcer with a haemorrhagic base. The bowel showed no other lesion. The abdominal and thoracic organs and the brain were healthy. Both middle ears contained a little pus.

Case 4, male, aged three months, born after a normal, full-time pregnancy, was admitted on May 30, 1926. He was small and much emaciated. He had been healthy at birth (weight 10 lb.). After receiving breast milk for a fortnight the feed was changed to diluted cow's milk. He failed to thrive, lost

weight steadily and was very cross. There was no diarrhoea or vomiting. Two days before admission he had repeated convulsions. Intraperitoneal saline and blood transfusion were without effect and the child died on June 1. At autopsy, a little 'coffee-ground' material was present in the stomach. A duodenal ulcer $\frac{1}{2}$ inch in diameter was present about 1 inch beyond the pylorus. Its walls were firm with some apparent surrounding fibrosis. The base of the ulcer was formed by the pancreas. About $\frac{1}{2}$ inch farther along the duodenum a second smaller superficial ulcer was discovered. No other intestinal lesion was found and there was no gross morbid change in the thoracic or abdominal organs. The brain substance was normal except for slight oedema. Some of the meningeal veins were thrombosed with slight subdural and subarachnoid haemorrhage.

Case 5, A. F., male, aged eleven weeks, was admitted in an emaciated state on December 3, 1937, with a two days' history of frequent vomiting and green diarrhoea. A right inguinal hernia was present which was at once reduced under anaesthesia. On December 12 the child looked very pale, collapsed suddenly and died. At autopsy the gastric mucosa was engorged. The duodenum which was moderately congested showed three small ulcers in the first part. The largest and deepest, about $\frac{1}{2}$ inch in length, was situated immediately beyond the pylorus. The ulcer had perforated the muscle, but the serosa was intact. The other two ulcers were smaller and superficial. Marked mucosal congestion was present in the rest of the bowel. The thoracic and abdominal viscera and the brain were healthy. Mucopus was present in both middle ears. The ulcer was examined histologically when the lesion was purely destructive, all coats of the bowel having been eroded without any attempt at repair. No organisms were seen in Gram-stained sections and haemorrhage was absent.

Case 6, I. C., female, aged six months, born at term after a normal labour, was admitted on December 17, 1917, with a complaint of vomiting and nasal catarrh since birth. She had been breast fed for four months; various artificial feeds had subsequently been tried without improvement. On several occasions the vomitus was of 'coffee-ground' type. On admission the child was pale and thin with a distended but lax abdomen, showing no peristalsis. Several attacks of haematemesis occurred in hospital, bright red blood having been brought up on one occasion. On December 22 the abdomen was opened, when a thickening was felt just beyond the pylorus and gastro-enterostomy was performed. Death occurred four days later. At autopsy slight recent peritonitis was present and the left lung showed a patch of broncho-pneumonia. The stomach and duodenum were preserved intact as a specimen but could not be traced. There is no note of the findings, hence the diagnosis of peptic ulcer in this case rests on the clinical findings which were pathognomonic.

Case 7, J. D., male, aged five weeks, born at term without chloroform or instruments, was admitted on October 2, 1941, moderately jaundiced, anaemic and wasted. Icterus had been present for the previous ten days and the child had been losing weight steadily. Two dark-coloured motions were passed shortly after admission. These gave a positive guaiac reaction. Death occurred two days after admission. At autopsy the liver which was dark-green showed no cirrhosis, jaundice evidently being of catarrhal type. The right and left hepatic ducts were patent and a probe passed readily along the common duct formed by their union and emerged at the ampulla of Vater, which was blocked by thick mucus. The gall-bladder was a small collapsed structure containing similar material. Its minute duct was quite impermeable to the passage of a probe. In the first part of the duodenum on the posterior wall

three small ulcers were present, the largest and deepest measuring 0.2 by 0.15 inch. The other two were very small and superficial. The duodenal mucosa was moderately congested. A small amount of altered blood was mixed with the contents of the lower ileum. Nothing of note was found in any of the abdominal viscera and the brain was healthy. The right lung was the seat of diffuse broncho-pneumonia. On microscopic examination the ulcers had not invaded the entire thickness of the duodenal wall; the longitudinal muscle coat was partially eroded, but the circular muscle was intact. The inflammatory reaction was negligible. No organisms were seen in sections stained by Gram's method.

Case 8, E. McA., female, aged ten weeks, born at term, was admitted on March 9, 1914, with a history of frequent non-expulsive vomiting since birth. She had been breast fed for one month: subsequently various artificial foods had been tried without improvement and she appeared to be often in pain. Large doses of oleum ricini were given during the first two weeks of life. The condition did not improve and death occurred on March 16 after several convulsions. At autopsy an ulcer $\frac{1}{4}$ inch in diameter was present on the posterior wall of the duodenum immediately beyond the pylorus. The state of the other organs is not described nor does the report state whether blood was present in the gastro-intestinal tract.

Case 9, C. C., female, aged six years, was admitted on December 22, 1922, as an accident case (nature unspecified) in a condition of profound shock. x-ray examination revealed a right-sided pneumothorax. On December 27 blood was passed per rectum for the first time. Haemorrhage recurred on December 27 and 28 despite intramuscular injection of blood and of horse serum. Death occurred on December 29. There was no history of any previous gastric trouble, the child having been in good health prior to the accident. At autopsy the right lung was torn and haemopneumothorax was present. Immediately beyond the pylorus was a large duodenal ulcer adherent to the head of pancreas. In its base was found a small bleeding vessel, the source of the blood which filled the stomach and bowel.

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