A British Medical Association Lecture ON THE SYMPTOMS AND SIGNS OF ABDOMINAL CRISES IN CHILDREN.*

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My definition of an abdominal crisis is a condition which demands the mind of a physician to diagnose and the hands of a surgeon to treat. Fortunate is the man who can exercise both these faculties, and still more fortunate the patient who calls him into consultation. Moynihan has said that the abdominal surgeon is a physician who is condemned to practise surgery. The double role, then, is not an impossibility. In these days acute abdominal diseases are less of a mystery than they were, and it is recognized that we ought, as a rule, to know the nature of the lesion before we open the abdomen. Nevertheless, the sick child will always present a particularly difficult problem, and I have the greatest sympathy with "The Doctor" in that well known picture by Sir Luke Fildes, for he obviously has not the faintest idea what is the matter with the child. It is more than half the battle to know when to open the abdomen, and the man who makes the fewest mistakes in diagnosis deserves the highest praise, for he will run the smallest risks with his patients' lives. This is, indeed, the counter with which we gamble, for abdominal exploration in sick children is a thing to be avoided. Whatever is done must be done quickly. Children are not good subjects for abdominal surgery, and much time is lost if the diagnosis is not made until the abdomen is opened.

For these reasons I propose to endeavour to put this subject before you from the purely clinical standpoint. The materials at our disposal will be the history of the illness and the patient, coupled with our book learning and our experience. These last two are perhaps the more important, for diagnosis is largely a question of assessing the odds, and from books and experience we can learn what the odds are. The history of the case and the evidence of the patient are notoriously deficient in the case of children, and in hospital cases this help is meagre to a degree.

The three steps in diagnosis are suspicion, probability, certainty. If a young child is brought to hospital with a history of passing blood and mucus per anum we naturally suspect intussusception. If inquiry proves that the onset was sudden and the trouble started with a fit of screaming in which the child was doubled up, it makes intussusception the probable diagnosis. If examination reveals a sausage-shaped abdominal tumour which can be rolled up and down, and still further if the apex of the intussusceptum can be felt by the rectum, all doubt is at an end and the diagnosis becomes certain. The history consists of two parts—first, the predominant symptom or chief complaint; and secondly, the progress of events following the onset. As we are dealing to-night with acute abdominal disease, suddenness of onset is of the essence of the contract. The previous health may or may not have been good—that will be ascertained with the detailed history; but the starting point of our discussion is an acute onset suggestive of abdominal disease. What, then, are the cardinal symptoms of such disease? Abdominal pain, vomiting, alteration of the bowels from their normal phase of activity. The physical signs are alteration of abdominal contour, rigidity of abdominal muscles, and the presence of an abdominal tumour or mass. All other symptoms and signs are supplementary or complementary to these in a positive or negative sense, though I must add that urinary examination may by itself give the whole clue to the correct diagnosis. I may perhaps remark here

that to make a diagnosis of an acute abdominal lesion without knowing the state of the urine is never wise.

The child and the adult differ, but the difference is often exaggerated, though it is true that the field for diagnosis in children is limited by the fact that certain lesions are almost unknown in the first decade of life. Perforation of a gastric or duodenal ulcer and acute cholecystitis will at once occur to you as belonging to this almost unknown category. There are, however, examples of diseases very rare in adults but common in children. I need only mention intussusception and *tabes mesenterica*. Our book learning or personal experience is of the greatest value in this connexion, for when we approach the patient with an abdominal crisis we must be aware of all the possibilities and weigh them up as against the probabilities suggested by the history of the case. Another point of importance is the fact that specific fevers not infrequently have a pseudo-abdominal onset, and we must be particularly careful to bear in mind that when the history of the case is scanty we may easily mistake lesions above the diaphragm for those of the abdomen itself. Lesions which simulate acute abdominal disease must first be eliminated from the diagnosis. This may be done by instinct in many cases, but in others a conscious reasoning process is necessary, and oftentimes a very minute examination of the patient is required in order to rule them out. Perhaps we cannot do better than pass rapidly in review those extra-abdominal diseases which are likely to prove traps for the unwary diagnostician in the case of young children.

THE SPECIFIC FEVERS.

1. Scarlet Fever.

Vomiting is common at the onset, and if it is repeated and severe, as it sometimes is, abdominal disease, even peritonitis, may be simulated. Abdominal pain is sometimes complained of. The existence of a sore throat, high temperature, and very rapid pulse at the onset put one on the right track. If the disease is seen later the characteristic rash should solve the problem.

2. Enteric Fever.

This can hardly be described as an extra-abdominal disease, and at its onset it is sometimes remarkably like an attack of appendicitis. If the abdominal pain and tenderness be almost confined to the right iliac fossa there may be the greatest difficulty, but it is important to remember that the pulse in typhoid is slow in proportion to the temperature, there is apt to be mental confusion or torpor, headache, and the abdomen is tumid without reflex rigidity. A leucopenia is present rather than a leucocytosis. Examination of the stools by culture, or of the blood in an ox-bile medium, will go far to establish the diagnosis in the days before a Widal reaction will be a reliable guide. A typhoid perforation certainly comes under the heading of an abdominal crisis, one of the most serious, but this disaster rarely occurs before the third week of the disease, and thus the diagnosis is made easier. This complication is usually associated with a sharp fall of temperature, severe abdominal pain, and acceleration of the pulse rate. Local tenderness and rigidity are the leading physical signs.

3. Mumps.

Metastatic pancreatitis is well known as a complication of mumps, but as far as I am aware it rarely occurs in children, and the condition of the salivary glands is always a predominant feature of the disease.

4. Influenza.

The gastro-intestinal type of influenza with colicky pains, diarrhoea, and vomiting, does call for careful scrutiny. The pulse is apt to be slow and the temperature high. Pains in the back and limbs, together with orbital headache and prostration, are especial features. These are often associated with the usual symptoms of respiratory catarrh.

INTRATHORACIC DISEASES.

1. Pneumonia.

Of all the lesions above the diaphragm this is most likely to lead to error. Most surgeons of experience have to confess to having removed the appendix for

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pneumonia at some time or other. In my own case I have so far eluded the mistake in children, though I have been guilty of it on one occasion in a man. Yet it is in the case of children that the difficulty most often arises, and at least half a dozen times I have declined to operate when urged to do so by my house-surgeon or a medical colleague. Children suffering from peritonitis nearly always have an increased respiration rate and the alae nasi may be active. This, together with the absence of sputum, and but little cough with pneumonia in children, accounts for the difficulty. It must be remembered that pneumonia in children is rarely of the true lobar variety, and the physical signs will be those of bronchopneumonia. Very rapid respiration should at once suggest the true nature of the disease, even if vomiting has occurred and abdominal pain is complained of. The temperature is a poor guide, but a high respiration pulse ratio is characteristic of pneumonia. The patient with lung disease likes to lie on his side; the peritonitic patient prefers to lie on his back with the thighs flexed on the abdomen. The flushed face, labial herpes, and very active alae nasi are strongly suggestive of pneumonia. If there are signs of consolidation of the lung and the rigidity of the abdomen on palpation is intermittent, it is pretty certain that the real lesion is above the diaphragm, and I cannot lay too much emphasis on this absence of true and permanent rigidity, for it has enabled me to avoid laparotomy on several occasions. Such rigidity as is secondary to lung disease is voluntary rather than reflex.

It must, however, be remembered that peritonitis may be a complication of pneumonia. If it is a late one—and it most frequently is—the diagnosis is not difficult. But it may occur early in the disease, and evidence of fluid in the abdomen may be proof of a spread below the diaphragm.

2. Pleurisy and Empyema.

The physical signs in cases of pleurisy, which may or may not be going on to the stage of pus formation, are sufficiently clear to enable a careful clinician to avoid mistakes, provided he thinks of such a condition. This is commonly accompanied by some voluntary rigidity of the abdominal muscles, but between the attacks of abdominal pain, which may be somewhat pronounced, there is full relaxation. The activity of the alae nasi and rapidity of respiration should suggest a thoracic lesion. As regards friction rub it is true that such a sound may be heard low down in the axilla as the result of peritonitis alone, whereas that due to pleural inflammation is usually audible at the base of the lung posteriorly. This is also, of course, the likely position for the dullness on percussion.

3. Pericarditis.

This disease is apt to cause arrest of the movements of the diaphragm, and therefore the abdomen tends to become immobile. Such cases may easily masquerade as acute abdominal disease, since epigastric pain may be complained of and vomiting is sometimes severe. However, in cases of doubt a period of watching, together with careful examination of the cardiac area, will probably make the diagnosis clear.

4. Heart Disease.

Acute dilatation may be deceptive, but the urgent dyspnoea, with cyanosis and very rapid pulse, together with enlargement of the cardiac dullness, should point away from the abdomen. Chronic disease of the heart is well known to cause vomiting, and abdominal pain may be complained of. Infarction of the spleen or kidney may complicate matters, but a careful examination of the heart will reveal signs of a positive character.

NERVOUS DISEASES.

1. Intracranial Lesions.

Tumour, abscess of brain, and meningitis are all causes of vomiting, and the vomiting may be incessant, even resembling that of intestinal obstruction. Tuberculous meningitis is particularly likely to be confused with abdominal disease. Vomiting, obstinate constipation, and

abdominal rigidity are its especial features. The abdominal wall, however, is likely to be retracted, a condition which is hardly ever associated with abdominal disease, except high obstruction or a very recent perforation. This is the so-called carinate abdomen, which in a very fretful child, who screams whenever he is touched, goes far to make up the picture of tuberculous meningitis, though the symptoms may be suggestive of abdominal disease. It is true that tuberculous peritonitis may sometimes be present, but this usually leads to a tumid abdomen. Further, perforation of a tuberculous ulcer may occur, and the recognition of all three manifestations of tuberculosis would require a perfect genius to diagnose correctly. Most of these intracranial diseases lead to headache and coma in some degree, and if careful examination of the nervous system is made mistakes will rarely arise.

2. Functional Disease.

Anorexia nervosa may go to such a pitch that the repeated vomiting resembles that of obstruction, but it is hardly likely to reach that stage in children.

TOXIC CONDITIONS.

1. Cyclical Vomiting and Acetonaemia.

The former term has rather gone out of fashion and the presence of acetone and ketones in the blood is recognized as responsible for the repeated vomiting which occurs in these cases. It is, indeed, a vicious circle disease, and children are its commonest victims. In a first attack the resemblance to an acute abdominal lesion, particularly appendicitis, is very close. The onset may be severe, with initial abdominal pain and early vomiting. There is often abdominal distension and tenderness, mostly due to the repeated vomiting. If the caecum is distended there will probably be tenderness in the right iliac fossa, and therefore the diagnosis of appendicitis will suggest itself. The appearance of the child, however, should help. The eyes are sunken, with dark rings beneath them, the face is pallid, and the lips rather bright in colour. There is lethargy, with restlessness, and true sleep is not obtained. The tongue is coated and the breath—the most characteristic sign—is heavy, with a sweetish odour. This may pervade the room, if the child is not seen in a hospital ward. Listlessness, thirst, and absence of desire for food are notable symptoms, and probably there will be a history of constipation, with lack of energy, for some days before the vomiting has occurred. As the disease progresses coma and delirium make their appearance. The diagnosis, of course, depends on a careful urinary analysis, and, if time permits, a chemical examination of the blood. It must be remembered, however, that acetonuria is a result of repeated vomiting from any cause, and therefore one must be quite sure that there are no positive signs of the acute abdomen before resting satisfied with the diagnosis of primary acetonaemia. The question is one of degree, and if the acetone overshadows the other aspects of the case it is clear that this must receive immediate attention. Without going into the details of treatment I may remark that the response, even in grave cases, is most prompt.

2. Uraemia.

It is well known that gastro-intestinal symptoms may dominate the clinical picture in uraemia, but I think this is far more likely to arise in adults than in children. Paucity of urine and its high albumin content should settle the diagnosis.

OTHER DISEASES.

1. Intestinal Colic.

Several times have I had difficulty in diagnosing between "green apples" and appendicitis. Many errors in diet may give rise to irregular and excessive peristalsis. Severe gripping pains with intermittent abdominal rigidity and some degree of collapse are met with, but sooner or later diarrhoea is manifest, and this, together with a careful history, will usually prevent erroneous diagnosis. The pain of simple colic is nearly always relieved by pressure, and thus a peritoneal lesion is differentiated from it.

2. Food Poisoning.

This, as distinct from unsuitable or indigestible food, is associated with vomiting and early diarrhoea, and collapse out of all proportion to the degree of abdominal pain.

3. Iliac Abscess.

Many lesions may be responsible for such an abscess, and if it is situated in the right iliac fossa it may easily simulate an appendix abscess. The peritoneal physical signs, even if vomiting has occurred, will not be found to substantiate the false diagnosis, and investigation should lead to the discovery of the source of the pus, whether it be bone, joint, or glands. Probably the last is the most frequent source of doubt, but the low position of the abscess and its proximity to the pelvic brim are signs to differentiate it from an appendix abscess. Inspection of the leg will probably show a boil or septic cutaneous lesion. Flexion of the right hip is met with in appendix abscesses. Similarly a psoas abscess may resemble an appendicular one, but such symptoms as are present are rarely acute.

4. Henoch's Purpura.

A haemorrhagic diathesis is easily recognized if it presents external signs, such as bleeding from the gum and petechial eruptions. The disease, however, may affect the intestine and cause severe abdominal pain, vomiting, and the passage of blood and mucus per anum, and yet no spots may be seen nor evidence of bleeding elsewhere. Obviously such cases must at first sight resemble intussusception, and it may be that the correct diagnosis can only be made by the absence of the abdominal tumour without which an intussusception cannot really be diagnosed. In purpura it is common for vomiting to precede pain, in intussusception sudden and severe abdominal pain is almost invariably the initial symptom. Passage of blood by the bowel is not constant in Henoch's purpura, and probably this depends on the site of the intramural effusion of the bowel—the lower down it occurs the more likely is there to be bleeding per anum. If bleeding from the gums is present, and especially if reddish-purple spots are seen over the body, the diagnosis becomes easy, but the disease is on the whole a rare one. Of its etiology we are woefully ignorant. Some fever is common as well as abdominal tenderness. A tumour has been observed, and there are cases where it appears that intussusception has followed on Henoch's purpura. Evidence of such a sequence should be very conclusive before abdominal exploration is carried out.

I am afraid I may have wearied you with what must be regarded as an introduction to my main thesis, but in reality the mind of the clinician must contain thoughts about all these possible conditions. Consciously or unconsciously he must weigh them up, although the chief complaint and the leading signs in the case may enable him to discard them all. He then reaches the next phase, which is that of differential diagnosis among those acute abdominal states which demand operative treatment. He is convinced that an abdominal crisis is before him, but which is it? If abdominal diagnosis were degraded to the level of a guessing competition he would, in adults at any rate, plump for the appendix every time, for he would be right in 70 per cent. of the cases. In children, however, the preponderance of intussusception and the prevalence of trouble due to tuberculous glands bring down the chances of appendicitis to about even odds. Everyone seeks to be right more often than wrong, and therefore we must apply our minds carefully to the diagnosis. Much depends on its accuracy, for if we know before opening the abdomen what has to be done we can certainly do it quicker, and, above all, we can operate through the most suitable incision.

One word with regard to the attitude which is to be adopted in the elucidation of a child's illness. It is a truism that the history, which is so valuable in the case of adults, is apt to be faulty and inaccurate in the case of children. It is also usually held that a child is a bad witness and unable to locate its abdominal troubles, but personally I prefer to regard the child as an adult in miniature, and oftentimes with gentle encouragement he

or she can tell you what you particularly want to know. Infants almost always, and many other children, do put one off by their crying at the sight of a doctor, and the only hope lies in the exercise of patience. Perhaps Luke Fildes's doctor was right after all. Inspection is calculated to give most valuable information, but it must be with the clothes off.

DIAGNOSIS.

I am not going to consider abdominal injuries, and there are certain organs which can be dismissed from our minds because they so rarely figure. The stomach and duodenum interest us only from the possibility of pyloric stenosis or duodenal atresia. The liver and the bile passages need hardly be considered, and the pancreas is also ruled out by the rareness of its disease in the young. However, during the last few weeks acute cholecystitis has been operated on in a child of 3 at St. Bartholomew's Hospital.¹

The spleen and the female genitalia can almost be disregarded, although I have elsewhere² published a drawing from life of torsion of the broad ligament and Fallopian tube in a girl aged 11 (Cassidy and Norbury's case, *Lancet*, 1911). External hernia which has become strangulated is not likely to be overlooked if one always insists on seeing the whole child stripped. We are left, then, with varying pathological states of the peritoneum itself and the intestinal tract. The problem sounds a simple one.

The first premiss is abdominal pain, presumably acute, and of recent or sudden onset. The difficulty is the localization of the pain. I think it may be accepted that visceral pain is a referred pain, not felt in the organ itself, but in the area of distribution of those spinal nerves whose nuclei lie closest to the spinal nuclei of the afferent sympathetic nerves from the seat of disease. In the early stages abdominal pain is either diffuse or central in position, and it requires an intelligent child patient to tell you where the pain is felt. If the child is old enough it is well worth asking, but not too much reliance must be placed on the reply. It may be judged by the child's behaviour whether the pain is constant or intermittent. In the latter case crying and screaming will result with quiet periods between. If the pain is constant the child is fretful and sleepless and resents all interference. The pain of obstruction is well known to be colicky in nature, and no better example can be seen than in intussusception where the onset is usually with screaming and a doubling up of the legs on the abdomen. This precedes vomiting. Other varieties of obstruction manifest this intermittent pain, and the best information will be secured if the abdomen is watched and palpated when the attack is in progress. The pain due to enlarged ileo-caecal glands is also intermittent, probably from interference with regular peristaltic waves in the neighbourhood of the ileo-caecal valve.

Continuous pain is more evident in peritoneal inflammation, and the characteristic attitude—the dorsal position with the legs drawn up—is an effort on the part of the patient to secure relaxation of muscles. Movement is resented. If there is evidence as to the place where the pain is most acute, there will probably be rigidity in the same area and the causative lesion of the peritonitis may be definable. Though appendicitis in its early stages causes diffuse or central pain, sooner or later it nearly always settles in the right iliac fossa, and unless there are physical signs here or hereabouts I defy the clinician to make the diagnosis with certainty. Allowance must of course be made for variability due to a high appendix, a retro-caecal appendix, or a low or pelvic one.

Vomiting may next occupy our attention. That of pyloric stenosis is so characteristic as almost to justify a diagnosis without examination. When a small infant ejects stomach contents, without bile, right over the edge of the bed—the record, I believe, is seven feet—it is very suggestive. If in the same child there is a history dating from shortly after birth with visible gastric peristalsis, pyloric stenosis is almost certain. If careful palpation of the right hypochondrium reveals a small tumour, best felt by the pressure of one finger, it becomes clear that the case is one of hypertrophic stenosis of the pylorus. Such children do not cry, but they writhe as the peristaltic

waves pass across the abdomen from left to right. If there is bile in the vomit and no tumour we may be able to diagnose duodenal atresia.

The vomiting of obstruction differs from that of peritonitis. It is forcible, and in the early stages of the obstruction it often comes on shortly after taking food. It is not usual now to talk about the progressive changes of the vomit from gastric to bilious, from bilious to stercoraceous and even faecal, because we are supposed to arrive at a diagnosis before these changes occur. Certainly it is true that stercoraceous vomiting in a child means a hopeless prognosis, but sometimes it has already occurred before the doctor is consulted. The vomiting of peritonitis and inflammatory abdominal lesions is associated with some degree of collapse. It is less forcible than that of obstruction, but nausea and retching are pronounced and quite often the vomit is bilious from the start. In the late stages of peritonitis the act of vomiting is almost effortless, and the vomited fluid is dark in colour, partly from altered blood, and offensive in odour. This is the product of the stage when paralysis of the intestine has set in; the stomach remains active almost to the end.

Abdominal pain and vomiting alone do not make a clinical picture unless we know the precise seat of the pain. If it is in the right iliac fossa the chances are strongly in favour of appendicitis, but ileo-caecal adenitis may also be responsible.

The state of the bowels is the next symptom of importance, and this may entirely dominate the diagnosis. What comes out of a man is the lawful criterion of the state within. If a child with abdominal pain and vomiting is also passing blood per anum the odds undoubtedly favour intussusception. Piles and polypi also cause bleeding by the rectum, but there are few lesions which cause the evacuation of mixed blood and mucus resembling prune juice, which is so characteristic of intussusception. If this is not mixed with faecal matter a rectal examination, which is, of course, a part of the routine abdominal examination, will go far to settle the diagnosis. Severe diarrhoea and dysentery are associated with bloody stools containing mucus, but some faecal matter is usually present. During the diarrhoea and vomiting season in hot summers at children's hospitals cases of intussusception may be overlooked, but it is consoling to know that intussusception is not increased in frequency by such epidemics, and if an intussusception baby does turn up among the other patients it will almost certainly be the best-looking child, and most likely a boy: 70 per cent of the intussusception babies under 12 months of age are males, and nearly all of them are well nourished. The contrast in appearance with the miserable "D. and V." infant is most striking. Blood may be passed in the stools in very toxic cases of peritonitis, but the blood is usually dark in colour, and it probably comes from the small intestine.

Pus passed by the rectum is a striking symptom, and a pelvic appendix abscess not infrequently evacuates itself in this way. Pus per anum, however, does not necessarily mean an intraperitoneal infection, and search must be made for the abscess, which may be connected with bone disease.

Now as to the question of diarrhoea or constipation. The latter is the commoner in acute abdominal disease because the bowel is either obstructed or the peritoneum is inflamed, and both these conditions will account for peristaltic arrest. It is important to remember, however, that diarrhoea is quite common at the onset of acute appendicitis, and that it occurs also in tuberculous peritonitis, though in this disease there is often a history of alternating diarrhoea and constipation. The three symptoms, sudden abdominal pain, vomiting, and constipation, at once make one think that the condition present comes under the heading of "the acute abdomen," and we may well pass on to a consideration of the physical signs whereby the differential diagnosis is made.

Physical Signs.

To return to "The Doctor": first watch your child, then diagnose him. Much may be gained by sitting by the bedside and observing the position and facial aspect of the

child. Note whether he cries or lies still. Most children in health are either very much awake or very deeply asleep. An apathetic or listless child is clearly ill. If by any chance there is the sweetish odour of acetone noticeable the explanation may be simple; but remember that acetonaemia of some degree is consequent on repeated vomiting from whatever cause. It may be an effect, and we are out to ascertain the cause.

The position of the patient has already been referred to, and the dorsal decubitus is preferred by nearly all children with peritoneal lesions. Occasionally, however, an appendix patient will prefer to be on the right side, and flexion of right hip and knee will be found. Restlessness is another characteristic of severe peritoneal involvement.

Pulse and temperature I shall not consider separately because they are very poor guides to the diagnosis unless the case is watched, and usually it is incumbent upon us to arrive at a diagnosis at the first examination, or very soon after. A pulse rate of 120 in a child may result from a very trivial cause. Similarly the temperature of a child may shoot up with very little to account for it. An infective lesion is rarely afebrile throughout the course of the illness, and this certainly applies to appendicitis, but the onset is often associated with some collapse and the temperature may be subnormal. Intestinal obstruction does not as a rule cause fever unless the stage of secondary peritonitis be present. Rigors sometimes occur at the onset of peritonitis, and in young children they may be represented by fits. Repeated rigors with a high peaked temperature chart are suggestive of portal pyaemia. Inspection of the abdomen may reveal definite retraction of the anterior abdominal wall. As already mentioned, this is common in meningitis and after severe diarrhoea and vomiting. In simple intestinal colic also it is met with intermittently.

The most common state of the abdomen in disease is distension, and this applies equally to obstruction, unless it be very high up, and to peritonitis. It is a characteristic feature of tuberculous peritonitis. If there are also several masses to be felt in the abdomen with evidence of free fluid these signs go far to make this diagnosis clear, especially if there be a history of alternating diarrhoea and constipation. Intestinal obstruction naturally leads to abdominal distension, and if this be coupled with visible peristalsis the problem becomes a question of the cause and site of the obstruction. It is not usual, however, to find much distension, or visible peristalsis, in cases of intussusception in the early stages.

Inflammatory masses or tumours of the abdomen may cause both visible and local protuberance. This is most often seen in the right iliac fossa in connexion with disease of the appendix; if there be such a visible tumour in appendicitis it nearly always means that there is an abscess. It is important to remember that the commonest tumour in the hypogastrium is a distended bladder, and until it is quite certain that the child has passed water it is dangerous to attempt a diagnosis of any tumour in the lower abdomen. If any doubt arises a catheter should be passed.

Visible peristalsis has already been referred to, and is a most valuable diagnostic sign of organic obstruction, whether it be of the stomach or small or large intestine. Such peristalsis can often be excited in the case of the stomach by a drink, or by stroking or flicking the abdomen, and when it is seen it is commonly painful for the patient. It should be remembered that such obstruction may be due to lymph exudate, the result of peritonitis binding coils of small intestine together. Its presence, therefore, does not eliminate peritonitis from the diagnosis.

Respiration in children is normally of the abdominal type. If there is limitation of the normal respiratory excursion it suggests that the quiescence is due to inflammation of the peritoneum. Most children can be persuaded to take a big breath, particularly if the examiner shows them how it is done by opening his own mouth wide and inspiring deeply. If then respiratory movement is absent over the whole abdomen it is indicative of general peritonitis. If it is absent over part it will usually be the lower portion. Such limitation is common in appendicitis with local peritonitis, and in pelvic inflammation.

Palpation.

If an abdominal surgeon is really a physician who can work with his hands there is no doubt that constant practice will almost endow him with eyes at the tips of his fingers. The hand, warm, reasonably soft, and gently applied, is the surest instrument in the diagnosis of abdominal disease. Constant inspection of the interior of the abdomen enables the surgeon to visualize the state of its contents. The ideal to aim at is to see before operating what is the other side of the abdominal wall. The method of palpation must be adapted to the patient. There must be no hurry, and there should be little guess-work. Every consideration of history, symptoms, and visible signs leads up to the final test of abdominal palpation. For this purpose the patient should be flat on the bed. The abdomen cannot be palpated with the patient in the Fowler position. The hand also should lie flat on the abdomen, and when the child ceases to resent this, gentle deep pressure should be exerted by flexion at the metacarpophalangeal joints. Unless the child can be coaxed sufficiently to lie still without crying this examination will be a failure, and it may be necessary to give an anaesthetic to get rid of voluntary contraction of the abdominal muscles. Much may be learnt by keeping the hand flat upon the abdomen, if the child is crying, and waiting for the relaxation which comes before the next inspiration; then the pressure can be increased, and thus an otherwise impalpable tumour may be felt. This method succeeds admirably in cases of intussusception and pyloric stenosis where the discovery of a tumour is essential to the true diagnosis. In both cases an anaesthetic is justifiable if satisfactory palpation cannot otherwise be secured. Sensitive parts of the abdomen should be palpated last; negative observations are just as valuable as positive ones.

Two hands may be required for successful palpation, and this is the only way to decide the nature of any lumbar swelling. Bimanual examination, with one finger in the rectum and the other hand flat on the abdomen, is of the greatest use in children, but this should be the last step in examination. Where intussusception is suspected this method should always be used. The apex of a large intussusceptum can be felt by the rectal finger, and a complete confirmation of the diagnosis may be obtained by finding an absence of the normal resistance in the right iliac fossa. Between 60 and 70 per cent. of intussusceptions are of the entero-colic type, and begin near the ileocaecal valve; therefore if the tumour reaches the rectum it is clear that a gap must be left in the right iliac fossa. This "signe de Dance," as it is called, provides very positive evidence. A pelvic abscess, or intrapelvic tenderness, may be impossible of diagnosis except by careful rectal examination. The presence of any vaginal or rectal discharge should be looked for when this pelvic examination is made.

There are two types of hyperalgesia which can be elicited by palpation—superficial and deep. Cutaneous hyperalgesia or hyperaesthesia is best discovered by pinching up the skin, but personally I have not much faith in the accuracy of this method of diagnosis. Deep tenderness, or pain caused by firm pressure through the abdominal wall, is, of course, very suggestive of an inflammatory lesion beneath the examining hand.

Muscular rigidity is one of the most important signs to be found on palpation. It varies greatly in degree, and is well known to occur in its severest form in perforative peritonitis. In the case of perforated gastric ulcer the diagnosis may almost be made on a degree of muscular tension, which is appropriately called "board-like" rigidity, but this is not a lesion we are likely to encounter in children. I know of a case in a child of 12, and I believe it has been described several times in children under 5, but I do not suppose it was diagnosed.

Rigidity of the abdominal wall is essentially an involuntary reflex response, and usually to a subjacent peritonitis. In children, however, I have seen general peritonitis with quite a soft belly wall, and its degree of contraction depends to some extent on the normal muscularity of

the patient. Simple colic may cause extreme local rigidity, but pressure rather relieves than increases this. In obstruction, before peritonitis ensues, rigidity is definitely absent. If oedema of the abdominal wall be found it is a clear indication of a subjacent suppuration.

Abdominal Tumours.

Some abdominal tumours may be seen as well as felt. It is important to remember the common physiological tumour of the child—namely, a full bladder. Tumours of an inflammatory nature may be felt in any part of the abdomen. They are usually tender, and, if near the surface, they will almost certainly be dull on percussion. It must be remembered, however, that there are such things as gas-containing abscesses, and as a matter of fact I have found them more often in children than in adults. Whilst yielding some resonance on percussion, they are definite masses and exquisitely tender.

One of the abdominal masses which is a source of error in diagnosis is a tongue-like process of the right lobe of the liver. This is Riedel's lobe, and I have known it mistaken for the tumour of an intussusception. Similarly the kidney, usually the right one, may be mistaken for a pathological tumour apart from renal disease. If the spleen is palpable it is almost certain that it is diseased.

The actual diagnosis of an abdominal tumour which is not inflammatory depends on its position. Multiple masses are felt in tuberculous peritonitis, and these are usually omental in origin, being fibro-caseous deposits with or without suppuration. These, again, may be mistaken for intussusception. The other common cause of multiple lumps in the abdomen is constipation, whereby masses of solid faeces may be arrested along the course of the colon. These have a characteristic doughy feel, and are definitely limited in position by that of the colon. Sometimes an enema is needed to differentiate them from omental masses.

Percussion.

All abdominal percussion should be light. Tenderness under such examination is very suggestive of peritonitis. Dull areas should be carefully mapped out, and the flanks especially must be percussed. Shifting dullness in the flanks is the surest evidence of free fluid, unless there is enough fluid to give an obvious thrill. Where peritonitis is diagnosed dullness in both flanks means that it is general peritonitis. In appendicitis there is often dullness in the right flank only, and this is commonly associated with rigidity of the oblique muscles. When the small intestine is overloaded with fluid and gas splashing may be elicited.

Auscultation.

Not sufficient use is made of the stethoscope in abdominal diagnosis. Peristalsis of unusual activity is audible without a stethoscope. Normal peristalsis can be heard with one. Entire absence of peristaltic sounds is very strong evidence of peritonitis, local or general.

CONCLUSION.

In concluding my remarks I must, if I wish to make this review of abdominal crises in any way complete, forsake the purely clinical method, and for purposes of description assume the diagnosis before describing the signs of disease. I have already said that examination of the urine may point the way to the correct conclusion, and this applies, above all, to that variety of infection which is due to the *Bacillus coli*. I am confining myself to that manifestation of the disease which has an acute onset and essentially abdominal symptoms. It is quite common in children, and affects girls more often than boys. Diffuse abdominal pain, nausea, vomiting, and constipation are all present. Shivering may occur at the onset, and the temperature is high. There is a rapid pulse, and headache may be complained of. The tongue is thickly coated and dry, and the face tends to be flushed. The abdomen is tumid and tender, and often this tenderness is most marked in the flanks, which may be rather rigid. It is the situation of the tenderness and rigidity which frequently puts one on the track of the right diagnosis. One or other

rectus may be held taut, and if this is so on the right side it is easy to mistake the condition for appendicitis. Tenderness in the hypogastric area is also met with, and the bladder may be full. Any attempt at bimanual palpation of the kidney region may be strongly resented, or even impossible. Examination of the urine reveals that its reaction is acid, and its naked-eye appearance may vary from mere opalescence to thick turbidity from the presence of bacilli, pus, and epithelial debris. The microscope may be necessary, and sometimes we must await the result of cultural investigation.

Another lesion which I must confess I find difficult of diagnosis is pneumococcal peritonitis. This is essentially a children's disease, and it has occurred in infants aged 3 months. It occurs twice as often in girls as in male children, and the common explanation of this is that it is due to an infection from the Fallopian tubes. This I believe to be perfectly true, and I confess that I have rarely diagnosed it correctly except where there has been a vaginal discharge or a definite history of preceding chest trouble. In the latter case the infection is via the blood stream.

Pneumococcal peritonitis presents three definite clinical types—namely:

- (1) A severe toxic form with acute onset, diarrhoea, vomiting, and abdominal pain, resembling general peritonitis of appendicular origin.
- (2) A subacute type resembling typhoid, with tumid abdomen, regular fever, and constipation.
- (3) An almost chronic and insidious form bearing resemblance to tuberculous peritonitis, with abdominal discomfort rather than pain, and slight fever. The bowels may be constipated, but quite often they act regularly.

The physical signs are those of diffuse or local peritonitis, and quite a number of these cases, in whatever way they begin, may settle down to a local intraperitoneal abscess. In the first type the child is desperately ill and the Hippocratic facies may be present, but the surprising thing is that the abdominal rigidity is slight. Examination of the chest does not often reveal evidence of either active or recent disease. Labial herpes is observed in a few cases.

I have already alluded to the presence of vaginal discharge in young girls. It sometimes affords the clue to pneumococcal peritonitis. On the other hand, the organism present may more closely resemble the gonococcus, and true gonorrhoeal peritonitis may be met with in children, but I am afraid I can give you no suggestion as to how often it has been proved to be the cause of peritoneal disease in girls under 12.

Of the rarer varieties of obstruction I have said little. Who can diagnose volvulus, internal hernia, or strangulation through an omental aperture in a child? We may be suspicious of them, but apart from intussusception the chances in intestinal obstruction in children are in favour of adhesions due to former peritonitis, possibly appendicitis, and those due to a tuberculous gland. I do not think we can hope to get much further. A scar of a previous abdominal operation does help the diagnosis of obstruction, and especially if we know what the scar represents. Remember, also, that recurrent intussusception is not so very rare.

I have explained the need for complete investigation of the cases for the purpose of full and accurate diagnosis so that the necessary operation shall be as brief as possible. This is an ideal we cannot always achieve, and everyone must realize that the limit of his powers may be reached if he separates non-abdominal from true abdominal diseases, and if he is able to differentiate peritonitis from obstruction. Having reached the diagnosis of the "acute abdomen" let us separate the inflammations from the obstructions, and, above all, let us pray that we may avoid the error of opening the abdomen and finding no disease therein.

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CHOLECYSTOGRAPHY.

A REPORT OF FIFTY-THREE CASES CONTROLLED BY OPERATION.

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(With Special Plate.)

THE diagnosis of disease of the biliary passages can usually be arrived at with a considerable degree of accuracy by the ordinary methods of clinical history and examination. None the less, the need for accurate methods of physical demonstration such as are now available in urological diagnosis has for long been felt. Whilst with modern technique a radiogram may disclose the presence of gall stones, a greatly thickened gall bladder, or a persistent deformity of the duodenum due to pressure or traction by a diseased gall bladder, the evidence thus obtained is of limited value, as with negative evidence we have no proof that gall stones are not present, nor that we have a healthy and functioning gall bladder.

The demonstration by Rosenthal that in tetrachlor-phenolphthalein we had a substance which was excreted by the liver in the bile, and thus a means of testing liver function, was the basis on which Graham evolved his method of cholecystography. On the grounds that certain of the haloids are opaque to x rays, Graham, in a series of animal experiments, was able to demonstrate that the intravenous injection of calcium tetrabrom-phenol-phthalein and tetra-iodo-phenol-phthalein, and in later experiments the sodium salts, was followed in a few hours by the excretion of the salt in the bile and by a visible gall-bladder shadow.

The experiments of Rous and Macmaster had previously proved that the gall bladder had an important function in concentrating the bile. Graham's experiments confirmed this significant observation, for whilst the gall-bladder shadow became more and more intense from the sixth to the eighteenth hour after injection, the ducts were seldom, if ever, visible in the radiograms. Graham showed that, whilst the bromine and iodine salts in large doses were toxic to animals, it was possible to administer a dose sufficient to demonstrate the gall bladder and yet free from dangerous toxic symptoms. A dose of 0.25 gram per kilo of body weight was non-toxic for animals and gave a clear gall-bladder shadow. A larger dose caused toxic symptoms. For the human subject a dose of 0.1 gram per kilo of body weight was used. The bromine salt was the less toxic drug, but was somewhat less efficient from the standpoint of radiographic demonstration. Recently Graham has shown that the iodine compound, if carefully prepared, is little, if at all, more toxic than the similar bromine preparation. Milliken and Whitaker report strongly in favour of the iodine salt, which, they maintain, is as safe as, and more efficient than, the bromide. Following Graham's publications, the use of this method in the human subject has now been widely adopted, and evidence is accumulating which goes to show that in cholecystography we have a valuable addition to our methods of physical diagnosis. The largest series of cases reported is that by Carman from the Mayo Clinic, and the evidence from this source is entirely encouraging.

This paper deals with 53 cases, in all of which a cholecystogram was taken prior to an operation on the upper abdomen. The cases included, not only those in which a biliary lesion was suspected, but many in which the dyspeptic symptoms pointed clearly to duodenal or gastric ulcer. We thus obtained a considerable number of controls—an essential in assessing the true value of the method. The method employed in this series of cases was the intravenous injection of sodium tetra-iodo-phenol-phthalein. As results depend largely on the care exercised and the technique employed, we give that used by us in some detail.