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APPENDICITIS IN CHILDREN.*

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The subject of appendicitis has, during the last decade, received so much attention that one might suppose that there was but little more to learn concerning this rather puzzling disease. The term puzzling can certainly be justly employed, at least when speaking of its etiology, for we must frankly confess that our knowledge of this subject is but little further advanced than when the disease was first named appendicitis. We have, of course, learned much about its symptomatology, but even to-day I know of no surgical disease which more often offers surprises to the operating surgeon. The symptoms, or at least our interpretation of the symptoms, do not always indicate the actual condition of the appendix. I need not narrate to you cases where an appendix in a threatening or dangerous state is found when the symptoms have been comparatively trifling. It is this uncertainty which has mainly led surgeons to advise very early operative interference in all cases. No one can certainly tell at the beginning of an attack whether perforation has or has not occurred, or that gangrene of the entire organ will not result in the course of a few hours. Of course, if possible, it is desirable to await the subsidence of the acute attack before removal of the appendix. The experienced surgeon can very often, by careful and frequent observations, safely carry the case along to the quiescent stage. This, however, can not always be done, and it is because of the exceptions that all surgeons are now practically agreed that the best results, both for preservation of life as well as of the strength of the abdominal wall, are obtained if the appendix be removed in the early hours of the attack.

Unfortunately, for many reasons, this practice can not invariably be carried out, and many cases are, and will continue to be, thrust into our hands, which have passed beyond the early stages of the disease. In such cases immediate operation will not always give the best results. There can be no doubt, I think, but that this rule of treatment should be almost absolute, provided that the infection is confined within or to the appendix itself. When, however, the infection has spread beyond, whether through a perforation of its wall or through the transudation of pyogenic bacteria through its inflamed coats, the propriety of advising immediate operation in every case becomes to my mind doubtful. A few years ago it was almost the universal feeling, I think, that

the appendix should invariably be removed as soon as possible, no matter what the stage of the disease. Personally, I have always felt that there were many exceptions to this rule, and for a year or two past the drift of surgical opinion has been, I think, toward less radical views on this subject. This drift has become still more pronounced since the treatment formulated by Ochsner has apparently shown that many a life can be saved by judicious delay. While I can not quite agree with Dr. Ochsner in his extreme position, yet I feel very strongly that his teachings on this subject are well grounded, and if followed intelligently, but not blindly, will tend to lessen decidedly the mortality of grave cases of appendicitis. Certainly my own experience during the past year or two has led me to this conclusion, for I feel that in some cases postponement of the operation for some hours has immensely aided the recovery of the patient.

For example: In cases where there has been a sudden perforation with resulting peritoneal shock of extreme degree, the patient is in a very poor condition for a serious operation, and the peritoneum as well is not as resistant against infection as it will be some twelve hours or so later. In such cases, where there is apt to be much abdominal distension, a weak and rapid pulse with symptoms of general shock, the postponement of the operation for twelve or twenty-four hours will often result in a very decided improvement in the patient's condition, provided that starvation be absolute. The abdomen will generally become less distended and the pulse will improve.

You may ask what bearing have these remarks on the title of my paper, "Appendicitis in Children." It is mainly concerning this point of treatment, however, wherein I think the treatment of this disease in children should differ from that among adults.

I do not think that it is properly appreciated, among general practitioners at least, how frequently appendicitis occurs in children. The operating surgeon very often encounters in the course of his operations on young adults the history of attacks of abdominal symptoms dating back to their earlier years, which undoubtedly, arguing from the state of the appendix found at operation, were due to mild attacks of appendicitis. It is often difficult to distinguish cause from effect, and unquestionably in many of these cases the previous abdominal symptoms may have been caused not by appendicitis, but by attacks of catarrhal enteritis, yet, at the same time, there are others whose attacks of indigestion, which have recurred at intervals since early childhood, immediately cease after removal of an appendix, which distinctly shows the results of years of recurring attacks of inflammation. Of course, I appreciate the fact that the surgeon encounters but a minute proportion of the intestinal cases among children, and because

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of the few cases where a later manifestation of appendicitis leads him to attribute the digestive ailment of childhood to that cause, he is, perhaps, apt to overlook the millions of young patients who have manifested similar symptoms, and yet whose appendices have never shown evidence of disease. I am willing to grant all this, but yet one can not avoid the conclusion that appendicitis in children is not an uncommon disease.

SYMPTOMS.

The symptoms on which we most depend for our diagnosis of appendicitis are pain, local tenderness, muscular rigidity, vomiting and abdominal distension. Pulse is often of value, as is also the temperature, but these two symptoms have more significance, perhaps, as regards the severity, rather than the actuality of the disease.

In children, especially those under 10 or 12 years of age, the important symptoms, with the exception of vomiting, are apt to be masked. Of course, the older the child the nearer the disease approaches the adult type.

As my experience increases, I am becoming more and more convinced that appendicitis in young children differs somewhat from the same disease in adults. The difference consists in the obscurity of the diagnostic symptoms, and in the more insidious progress of the disease. The younger the child the greater is the difference. The correct diagnosis of disease in young children is often beset with difficulties. Their inability to locate pain, their general restlessness and fretfulness and the unreliability of the significance of temperature are some of the causes of this difficulty.

Pain.—This, especially at the beginning of the attack, is, as a rule, probably as severe in the child as it is in the adult, but the uncertainty of its location impairs its value as a diagnostic symptom. A general pain in the belly is complained of, the child not knowing exactly where it is located, at one moment pointing to the upper, at another to the lower abdomen. It hurts everywhere, apparently not specially in the appendicular region. This symptom, which of itself in the adult is of great significance, can only help us in the case of children by its combination with other symptoms. In certain phlegmatic children there seems to be at times almost complete absence of pain. Tenderness to pressure is apt to be equally doubtful. The child generally dreads any palpation of the abdomen, and complains almost as much in one part as another.

Muscular Rigidity.—This symptom, which is, perhaps, our most important guide in the diagnosis of appendicitis in adults, is in children equally obscure. The child is suffering pain and is prepared to cry out, and unless taken unawares, to tighten its abdominal muscles as soon as or even before the skin is touched by the examiner's finger. The dread of being hurt causes the muscles to act on guard at almost any point of the abdomen. If the utmost gentleness and patience are practiced, along with diversion of the child's attention, sometimes this symptom can be elicited, and if certainly found, the diagnosis is at once confirmed.

Vomiting.—This is in children probably the most persistent symptom. It at least is the most evident. It is apt to continue in spite of starvation and medication. If it does so, and persists for many hours without other adequate reason, and if it be accompanied by severe pain with absence of intestinal movement, the suspicion of appendicitis should be very great. Persisting with severe abdominal pain for twenty-four hours or more, even with intestinal movements, the sus-

picion is still considerable. The accompaniment of diarrhea is, of course, unusual, and points more toward a gastroenteritis, but still it may occur with appendicitis.

If the abdomen becomes more and more distended the diagnosis of appendicitis becomes more and more probable. Of course, for a perfect picture we should also have either local tenderness or muscular resistance, but, as already stated, these symptoms in children are apt to be wanting.

The history of previous attacks of vomiting without adequate cause is of considerable diagnostic value. The surgeon is, perhaps, apt to lay too much stress on the importance of such "bilious attack," but if he does so it is because very frequently in the cases on which he operates such a history is given. It is important, however, that such attacks should be separated from those due to indiscretions in diet or an overloaded bowel.

The diseases from which, it seems to me, appendicitis in children is especially difficult to differentiate, are gastroenteritis, with the gastric element most predominant, diaphragmatic pleurisy and basal pneumonia. To my mind, certain of these doubtful cases are the most puzzling which the surgeon encounters. In certain cases of acute indigestion or of gastroenteritis in its early stages, the differentiation from appendicitis is not easy. The following points may be of some value: The persistence of vomiting with severe pain for more than twenty-four hours, especially if there be no diarrhea, favors the diagnosis of appendicitis. If the constipation be obstinate, the suspicion of appendicitis is generally sufficiently strong, should there be at the same time any one other symptom of this disease to warrant operation. If there be diarrhea, it generally, though not always, means that the case is at least less urgent.

The existence of high fever probably rather favors gastroenteritis. The blood examination may shed some light on the diagnosis. The differential count is of more value than the mere leucocyte count. There are, however, so many exceptions to the general rule that personally I do not feel much confidence in blood examinations in young children. Judging from a somewhat limited experience with the iodophilia test, it seems to me to offer more promise of valuable information than does either the leucocyte or differential count.

As an example of the difficulties, let me give the following history:

CASE 1.—Girl, aged 4. During her first year there were several attacks of pain, vomiting and fever, lasting a few days and then passing off entirely. In the second and third years these attacks occurred in milder degree. The child was always carefully dieted. In December, 1903, there occurred a sharper attack of pain, but there was no fever, no vomiting and no localization of the pain. Since that time until April, 1904, about once a week the child would complain of a sudden, sharp abdominal pain which would last, however, but a few minutes. It had no apparent connection with her meals and might occur when she was at play or out walking. The digestion was apparently always good, and the child looked well. There was considerable difference of opinion as to the diagnosis. The father, who was a physician, and myself felt, however, that the chances of the cause of the trouble was a chronically inflamed appendix. Accordingly, on April 11, 1904, it was removed. It was found markedly diseased, with the mucous membrane the seat of hemorrhages, and in a condition where perforation was imminent. Since the operation the child has been entirely free from pain.

To some of you it may appear foolish to dwell on the difficulty of differentiating appendicitis from diaphragmatic pleurisy, but it has been my lot to encounter sev-

eral cases where it has been for a time quite impossible to distinguish between these two conditions. Within the last few years I have been called on at least half a dozen times to either operate or decide concerning the propriety of operation in such cases. In these half dozen cases time has shown that I have been as often wrong as right in my diagnosis, though, fortunately, in the cases that have proved to be pleurisy or pneumonia, a half day's delay has in every case saved the patient from an unnecessary operation. Let me briefly relate three of these cases:

CASE 2.—Boy, aged 8, who had usually enjoyed good health, was seized on November 5, in the early morning, with severe abdominal pain. He was at once given a dose of castor oil and throughout the day this was followed by two doses of Rochelle salts. Later in the day vomiting began and continued more or less for twenty-four hours. There was some fever and a rapid pulse. The bowels refused to move in spite of enemata, the abdomen began to distend, the pain continued. The family physician called a children's specialist in consultation from New York (the child was in the country), and both were puzzled as to the diagnosis. There was no cough, and no pain was assigned to the chest. The vomiting continued, the abdomen was markedly distended, tender everywhere, and the child looked very ill. Prepared to operate. I saw the child toward midnight, twenty-two hours after the commencement of the attack. It was a question as to diagnosis, the vomiting, absolute constipation, abdominal pain and tenderness made a diagnosis of appendicitis or intestinal obstruction probable. There was a faint sign, however, of irritation of the lower left pleural surfaces, and we decided that a delay of a few hours was advisable. On the following morning the signs of pleurisy with probably a basal pneumonia were well developed. The child made a good though slow recovery.

In this case the entire absence for at least forty hours of any abnormal chest sounds and the severity of the abdominal symptoms seemed markedly to favor intraperitoneal inflammation. Until the abnormal chest sounds developed, diagnosis was impossible. The case was a most puzzling one, and the delay in awaiting the pathognomonic symptoms would probably have caused a fatal termination had the appendix been involved.

I do not feel that I can express views of much value as to the differential points between appendicitis and diaphragmatic pleurisy. Of course, I am now referring to cases where abnormal chest sounds are absent. Perhaps in cases of pleurisy a certain fixation of the lower ribs or stoppage of the respiratory movements at this point may be noticeable. Perhaps also the child is more apt to toss about the bed than he would be apt to do were his appendix inflamed, but even in this latter condition the child is much more apt to be restless than is the adult. If the child be inclined to assume the adult position of rest, on the back with the thigh or thighs drawn up, the chances are in favor of appendicitis; but, as already stated, children often fail to assume this posture. The passive flexion and extension by the surgeon, of the thigh on the abdomen, is in appendicitis, even in children, apt to be more resisted and dreaded than it would be in diaphragmatic pleurisy. Sometimes, but not generally, this symptom is of considerable value.

Of course, if there be a tender spot or muscular rigidity, the diagnosis is easy. If a boardlike condition of the abdomen develops, we may be certain that the case is a very grave one of partial peritonitis.

INSIDIOUS PROGRESS.

Another point to be considered is the progress of the disease and its treatment. The progress is often marked

by insidiousness. A case that is apparently mild will sometimes gradually drift, perhaps, without any alarming symptoms, into a grave condition with general septic peritonitis in spite of the most careful watching. The pulse and temperature may remain normal, vomiting may cease, distension may not be marked and the bowels may even continue to move, and yet a general peritonitis is developing. I am inclined to think that there is not the same effort on the part of Nature to wall off the inflamed appendix in children that so often occurs in adults. Not only is this spreading tendency of the infection insidious, but it is often very rapid.

I have encountered dozens of cases where the disease followed such a course. The following are examples:

CASE 3.—Girl, aged 13, was attacked in the early morning, April 21, 1904, with severe, sharp pain and vomited. The temperature reached 99½ and the pulse 100. The bowels moved during the day, the pain toward evening became less, and the whole aspect of the child seemed improving, the pulse became slower and the night was passed comfortably. In the morning, however, of the next day, in the course of a few hours, the whole aspect rapidly changed. The abdomen became boardlike, the countenance assumed an anxious appearance, and the pulse rose in frequency and was very wiry. There was also a tendency to vomit. At 11 a. m. of that day, April 22, an operation revealed an appendix almost entirely gangrenous and a general suppurative peritonitis. The child made a slow recovery.

CASE 4.—Girl, aged 5, was seized on the evening of Nov. 23, 1903, with abdominal pain. She vomited, and during the night was restless, temperature, 99½, pulse 90. The night was passed comfortably. On the next morning the child seemed brighter, and asked for her breakfast; temperature 99, pulse 85; very slight pain was complained of. When I saw the child at 11:30 of that day (November 24), the abdomen seemed to me rather tense, three hours later the tenseness was more marked and the child looked more ill. Operation performed at 4 p. m. revealed a perforated appendix and a general peritonitis. Thorough irrigation and drainage was employed and resulted in recovery.

I could narrate many other cases where the symptoms have for days been of the mildest degree, and apparently all abating, when suddenly the conviction is forced on the physician, that some change has occurred, and operation then reveals a hopeless general peritonitis. Dr. Brannan's¹ instructive case is another example of treachery in the behavior of the appendix.

In the children there also seems to me greater liability to rapid gangrene. Of course, in adults we often encounter cases where gangrene has been rapid and extensive, but this tendency strikes me as existing more frequently in children. The following case is an example:

CASE 5.—Girl, aged 11, in the evening of July 2, 1902, while in an automobile, was seized with severe abdominal pain. During the night there was slight vomiting and some fever (101 degrees). On the following morning the abdomen was rather tense, and while the pulse was not over 80 Dr. W. K. Draper felt that immediate operation was demanded. The tenseness of the abdominal muscles was suspicious. The operation was done just twenty hours after the appearance of the first symptoms, and the long appendix was found absolutely gangrenous from its tip to its very base and even beyond. A spreading peritonitis had begun, but the child made a good recovery.

REMARKS.

Because of this treacherous behavior of the inflamed appendix in the child, as well as the inferior tendency to limit the inflammation by adhesive peritonitis, I feel very strongly that in every case of appen-

1. Medical Record, April 30, 1904.

ditis in children immediate operation should be advised. No matter what the stage of the disease may be, I feel it much wiser to operate at once, and not delay in hopes that at a later date an interval operation may be performed. This advice is in accord with that of many surgeons for appendicitis at any age, but, as already expressed in this paper, I am not entirely in accord with such views, except in cases of children. The older the patient the less tendency there seems to me to be to spreading peritonitis, and the more unfavorable are the results of operation in grave cases.

My own experience with operations for general septic peritonitis has demonstrated to my own satisfaction that the results of the operation on young adults, if they be rapidly performed, are apt to be favorable, while those on patients over 40 or 45 are almost invariably fatal.

I thought it might be of interest to give the age statistics of 1,000 cases of appendicitis, at the time of their operation. While my operative cases number more than this, I have not included those of the last few months, as a round number like 1,000 seemed to me more convenient. I have also tabulated in 1,500 cases which I have personally seen, the ages at which, as far as could be ascertained, the first symptoms of inflammation of the appendix manifested itself.

TIME OF OPERATION OF 1,000 CASES.					
Age in Years.	No. of cases.	Per cent.	Age in years.	No. of cases.	Per cent.
1-2	3		15-16	14	
2-3	1		16-17	24	
3-4	7		17-18	28	
4-5	6		18-19	27	
1-5	17	1.7	19-20	20	
5-6	8		15-20	113	11.3
6-7	10		20-25	176	17.6
7-8	12		25-30	176	17.6
8-9	10		30-35	149	14.9
9-10	11		35-40	99	9.9
5-10	51	5.1	40-45	65	6.5
10-11	15		45-50	35	3.5
11-12	19		50-55	15	1.5
12-13	15		55-60	11	1.1
13-14	21		60-65	6	0.6
14-15	15		65-70	2	0.2
10-15	85	8.5	70-75	1	0.1

RATIO OF AGE TO FIRST SYMPTOMS IN 1,500 CASES.

The proportion which had the first symptoms in the first year is .003 per cent. of all cases.

In first 2 years	1.33
In first 5 years	7.5
In first 10 years	17
In first 15 years	31
In first 20 years	46
In first 25 years	54
In first 30 years	70
In first 35 years	82
In first 40 years	89
In first 45 years	94
In first 50 years	96
In first 55 years	98
In first 60 years	99
In first 65 years	99.5
In first 70 years	99.75
In first 75 years	100

From these statistics it will be seen that young adult life furnishes the largest number of cases of appendicitis. In those that demanded operation, the greatest number occurred between the ages of 20 and 35, the proportion being over 50 per cent. After 35 the proportion of cases becomes rapidly and progressively smaller, between 40 and 50 being but 10 per cent.

Before the age of 20, the proportion is 26½ per cent.; before the age of 15 years, 15 per cent.; before the age of 10 years, .068 per cent. The youngest cases in my series were 12, 12½, 16 and 20 months, respectively. Over 60 years, the proportion was nearly 1 per cent. (.009). The oldest case was 72½ years.

THE DIAGNOSIS OF APPENDICITIS.

SHOULD THE APPENDIX BE REMOVED WHEN THE ABDOMEN IS OPEN FOR OTHER CONDITIONS? *

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So much has been written and said about the ease of diagnosing appendiceal disease, so little stress has been laid on the occasional difficulty of making a correct diagnosis, that condemnation is heaped on those who fail to appreciate the real condition. Sight is lost of the fact that the best diagnosticians and abdominal surgeons are occasionally put to it to determine whether the appendix is the seat of the trouble or not. Mistakes are made by the very best surgeons. Each of us should profit by his own mistakes and the mistakes of his fellows, and each of us should be willing to give the whole profession his experiences, fairly and unreservedly.

I have only removed 272 appendices of which I have accurate records. In forty instances, multiple operations were done at the same séance, and in many of them the diseased condition of the appendix was not definitely diagnosed before opening the abdomen.

In 71 of these cases appendiceal disease was associated with or masked by one or more of the following conditions: In 4 cases by renal calculi; in 5 cases by gallstones or gall-bladder adhesion; in 18 cases by vague symptoms of indigestion, biliousness and indefinite colic; in 5 cases by frequently recurring dysentery or rectal disease; in 3 cases by acute intestinal obstruction, and in 2 cases of typhoid fever; in 12 cases by floating and diseased kidneys; in 1 case by acute septic nephritis; in 1 case by retroperitoneal tubercular abscess; in 3 cases by tubercular peritonitis; in 11 cases by marked menstrual disturbances; in 11 cases by disease of the uterine appendages; in 2 cases, retrocecal herniæ were mistaken for appendicitis, the appendices only becoming involved incidentally. In 2 other cases no diagnoses were made, but exploratory operations demonstrated appendiceal disease. In 1 case, in a young girl, a ruptured dermoid cyst was diagnosed appendicitis, and in another, a right salpingitis was diagnosed appendicitis.

I have done at one sitting, on the same patient, without unusual shock or prolonged convalescence, the following operations: Dilatation of the cervix and curettement of the uterus, removal of a number of enlarged cervical glands and hemorrhoids, anchoring a floating kidney, and removal of a diseased appendix. At another time I removed at the same sitting a diseased appendix, and did a gastroenterostomy for contraction of the pylorus consequent on gastric ulcers two years before.

In the process of evolution, medicine and surgery have reached a stage of development when such terms as colic gastralgia, acute indigestion and intestinal indigestion can no longer be loosely used in diagnosis without subjecting the user to just criticism. They are but symptoms of some definite chemie or mechanic defect in the digestive process, and careful investigation would reveal the underlying pathology, i. e., a contracted pylorus, gallstones or appendiceal disease, or partial intestinal obstruction from old adhesions.

Since Edebohls, Deaver and other leading members of the surgical side of the profession called attention to

* Read at the Fifty-fifth Annual Session of the American Medical Association, in the Section on Surgery and Anatomy, and approved for publication by the Executive Committee: Drs. DeForest Willard, Charles A. Powers and J. E. Moore.