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Mortality following appendectomy

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MORTALITY FOLLOWING APPENDECTOMY

SENIOR THESIS

ERROLL ALLEN MOSS

1934
This paper is being written with the idea of obtaining some information concerning a subject which to me is of vital importance. It is not being written for length to make the impression that it is so important to all those who may read it, nor is it written for brevity in order to accomplish a task within a short time. I have not made mention of all the authors as I go along due to the fact that there was so much overlapping in many of the articles. In fact I found three articles which admitted to no one as being the author of the article outside of the one doing the writing yet the wording was exactly the same word for word. These articles were all by different authors but there must have been something very common to all three regarding the subject at hand. I have given very few statistics such as just cold facts as figures mean very little unless there is some explanation of the conditions under which they were obtained. The thing that I have had in mind however to bring to light for my own satisfaction was the factors and the suggested factors responsible for the high death rate following appendectomy. Following out this plan I have tried to obtain a wide range of ideas both as to the men and also where they are located and under what conditions they worked in securing their data.
FOREWORD (cont)

I wish to thank each and every one of my instructors for the help and information which they all gladly gave when asked. I particularly want to express my appreciation to Dr. Poynter who gave me valuable suggestions as to the plan of carrying out this work and of the purpose in writing it. I feel that I have obtained a better knowledge of the facts with regard to appendicitis and its management and of the suggested factors which have to do with the mortality rate throughout the country following appendectomy. If there are any facts brought out that are of interest to the readers or if any new ideas have been presented to them I will indeed be pleased.
MORTALITY FOLLOWING APPENDECTOMY

The idea that problems of medical and surgical treatment of appendicitis are nearly solved are far from correct. During the year 1917 for example according to Dr. Finney (26) there were 9374 deaths from appendicitis. Nearly all of these deaths followed appendectomy and for that time covered the registration area in the United States. In 1919 there were over 10,000 deaths and in 1920 the deaths amounted to over 11,000. These deaths were distributed in the age groups as follows:

<table>
<thead>
<tr>
<th>Age</th>
<th>Number of deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>All ages</td>
<td>11,260</td>
</tr>
<tr>
<td>Under five years</td>
<td>425</td>
</tr>
<tr>
<td>Five to Fourteen</td>
<td>2,130</td>
</tr>
<tr>
<td>Fifteen to Forty-four</td>
<td>5,906</td>
</tr>
<tr>
<td>Forty-five to Sixty-four</td>
<td>2,229</td>
</tr>
<tr>
<td>Sixty-five years and over</td>
<td>570</td>
</tr>
</tbody>
</table>

Therefore in the two years from 1917 to 1919 we can see that according to these figures there was a decided increase in the number of deaths from appendicitis.

In this connection I was not able to obtain the
total number of cases of appendicitis in the registration area but a fair average figure for the mortality in all cases of appendicitis in this area as given by most authorities at that time was ten per cent. Therefore with 11,000 deaths in 1920 we know there were at least 110,000 cases of appendicitis at that time. This data shows that the public at large is not receiving the full benefits of the scientific knowledge at hand in caring for all cases of appendicitis and the relief of the disease.

On the other hand with a large amount of figures at hand it is a striking notation of the great range of figures. Some surgeons report as low a death rate as between one and two per cent in all cases of appendicitis and in some of our large hospitals under the master management of modern surgery the mortality is less than one per cent. However on the other hand some reports come in with a death rate as high as 20 per cent and in some definite cities as will be shown later the mortality will run even 30 to 35 per cent. This wide range of figures may be due in some part to:--

1. To what the individual surgeon regards as acute appendicitis.

2. To the time in the disease at which operation is performed.

3. To differences in the medical and surgical management of the disease.
It is obviously of little value to strike an average of the widely varying mortality statistics. Furthermore an especially low mortality rate does not always imply better surgical treatment nor does an especially high mortality figure condemn the work of the clinic reporting it. In the series that may be separated from everywhere, in order that there may be no question of the nature of the disease, we have included only cases in which there was no mistake as to the exact diagnosis and to the severity of the case. The reports therefore represent for the most part the results obtained in the surgical treatment of the most advanced and dangerous cases of a group or any number of groups. In one group of 262 cases in one series there is the report that 205 or 78.21 per cent were pus cases. A five day interval between the onset of the symptoms and the admission to the hospital had occurred in 144 of the 205 suppurative cases. A two-week interval had elapsed in 17 cases and three had been sick twenty-one days; one patient had gone twenty-eight days and one had gone along for thirty-three days. Therefore the time element must be considered. Of the 205 pus cases only 39, think of that, only 39 had been brought to the hospital sooner than five days after the symptoms had come on. Another factor making for higher mortality is that the majority of these cases had been severely purged before admission.
The purges used for the most part were epsom salts or Castor oil. Another factor to consider is the distance traveled in coming to secure treatment. Of the 262 cases studied in this series only 10 per cent came from the immediate neighborhood. Time intervals between the start of the disease and the date of admission are factors that must be considered. In many of these cases that were studied in this series by Dr. Gotch (28) and in other series very few of the patients had come in without a correct diagnosis. Therefore with correct diagnoses to begin with the correct treatment could be started at once.

An analysis of complications and deaths occurring in appendicitis by Dr. Finney (26) we find him reviewing a series of 3913 cases of appendicitis operated upon in the Union Memorial Hospital in Baltimore from the years 1900 to 1930 by a total of almost one hundred different surgeons including the writer himself. The report will limit itself to 91 deaths. Some of the deaths though following appendectomy include those from causes such as typhoid fever, scarlet fever and many other diseases which developed during convalescence and another cause such as a streptococcus causing a septicemia apparently coming from a throat infection and present at the time of operation. But if these deaths were thrown out as being unrelated to appendicitis and the appendectomies there can be a discussion and question as to the truthfulness of the statistics and there
would not be an actual definite percentage figure. By far the largest number of deaths are due to toxemias of peritonitis and this is a spreading peritonitis following removal of the appendix. The next large group where mortality was high is the one in which intestinal obstruction played a very large part. When we have pulmonary complications which bring up a large group of fatalities, this was true in both the acute and in the so-called chronic state. Terminal pneumonia occurred in many cases and seemingly in spite of all the best medical attention possible. There were a few cardiac deaths in this group also. Then there was a surprisingly low run of pyelophlebitis and sub-phrenic abscesses in cases which led to fatality. There was one case of a child who developed scarlet fever during the seventh week of convalescence from a peritonitis and promptly died of the scarlet fever. Then another case showed an appendical abscess developing during the second week of a normal temperature following a severe typhoid infection and the culture showed a pure culture of that organism. In 1919 during the influenza epidemic two cases of acute appendicitis came in showing white counts of 3,000 or less and both cases though operated on successfully died of a massive pneumonia. Both dying about the sixth post operative day. However Dr. Finney (26) feels that there is very little danger attached to operation per se and where the danger came from infection it was from an acute condition but even in these cases he found only 2 deaths in 2106 cases
which is less than 0.1 per cent mortality. Both of these deaths occurred in men of middle age and they were of the short thick pudgy build which marked them before hand as relatively poor risks. Both of these patients were also subjected to a very thorough abdominal exploration as well as the removal of the appendix. This was done through a right rectus incision. BOTH followed the same postoperative course; a paralytic ileus with progressive distension and total lack of peristalsis, dying after about a week with a terminal pneumonia. In each of these cases the absence of a peritonitis was definitely proved, one by a secondary operation and the other by findings at the autopsy table. In view of the mortality rate in the advanced groups this certainly furnishes a potent argument for early operation, and for no undue delay in doubtful cases. Sometimes it raises the question of considering prophylactic removal, but that is pretty severe treatment when other methods will prove much better. As to sex, according to the record the male incidence of mortality is almost twice to three times that of the female. Some men (10), (26) and (38) seem to think that the physiologic process of ovulation confers a certain immunity to an exceptional extent or unusual ability to take care of peritoneal infection. There complications which we might classify as "unrelated complications" and under this list can come those of colds, cases of tonsillitis and other infections which we do not commonly think of as being included as causes for mortality following appendectomy. Then we may have a group in which wound infections seem to be responsible for quite a large proportions of fatalities.
This heading includes all of the accidents and infections such as the slight superficial stitch abscesses in the skin sutures and also the breaking down and liquifaction of some of the adipose tissue. Then we include the severe infections such as severe fistulas and any other type of infection which may and can be traced as directly due to "Wound Infections".

One way to help cut down fatalities and infections causing fatalities is the use of sild to close the wound. Of course this is not universally accepted but in the minds of some of the surgeons there is strong belief that this may have much to do with the cutting down of mortality coming from that source. I am giving a group of figures as to the types of appendicitis and the results.

<table>
<thead>
<tr>
<th>Type</th>
<th>Cases</th>
<th>Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic type 827</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Recurrent</td>
<td>731</td>
<td>1</td>
</tr>
<tr>
<td>Subacute</td>
<td>548</td>
<td>0</td>
</tr>
<tr>
<td>Acute</td>
<td>1129</td>
<td>16</td>
</tr>
<tr>
<td>Abscessed</td>
<td>438</td>
<td>21</td>
</tr>
<tr>
<td>Peritonitis setting</td>
<td>in following removal 240</td>
<td>Deaths 52.</td>
</tr>
</tbody>
</table>

The use of morphine outside of allaying the pain seems to be of very little value. However in so many of
the cases that I read of I find that morphine is used in nearly every case that morphine is used to keep the patient at rest and ease both mentally and physically. Another factor that makes for lessened mortality is the use of a daily amount of fluid sufficient to keep the urine output at 1000 cc or more. The fluid may be given by mouth, by the intravenous route or by proctoclysis. Hypodermoclysis however is a source of intense pain and therefore the consensus of opinion of many authors is that it should not be employed. (26), (6), (22), (30) and (39). Proctoclysis is used in many cases wherever it can be carried out without too much discomfort to the patient. Another factor of helpfulness is the withholding of food after operation. One author (28) says it is best to withhold nourishment as long as there is any noticeable distention or nausea. In a severe case of peritonitis this may mean a period of starvation for a week or two days. Another factor is to be mentioned and considered and that is never to feed a patient who has a paralytic ileus. Such action is harmful and wasteful from the standpoint of the strength and body defenses of the patient. However to combat these long periods of starvation the use of intravenous injections of 2 per cent glucose solution combined with one to three units of insulin has been used. Gastric lavage is another very important treatment of post-operative peritonitis. Unrecognized distention of the stomach may prove fatal in just a very few hours, therefore when in doubt always pass a stomach tube. As to the periods of time
in between the passings of the stomach tube sometimes it is impossible to allow more than two hours interval as the distension in the stomach may occur so rapidly and due to the weakened condition of the patient the outcome may be fatal in from four to five hours if no relief is given.

In a condition of a generalized peritonitis, fatal case, we find that several authors are grouping the cases together, (41), (27), (31).

1. Those in which there is a general septiceamia in addition to the peritonitis. This is proved by blood culture.

2. The next group have used severe purges before operation. On this one thing ALL Authorities emphasize the bad effects of laxatives in appendicitis. The patient is dehydrated and the general resistance is lowered, the patient is weak and on the whole he is a much more decidedly poor operative risk.

3. Another group of fatalities seems to be due to the operative technique and the in the operations themselves. In this group of fatalities we find the cause to be in the undue manipulation of the bowel at the time of operation. The bowel is traumatized by the pulling, stretching and clamping on the wall etc.

Until a reaction against this vigorous and unnecessary action is set up we will continue to have deaths occurring at the high rate they now are. This rough handling accounts for the peritonitis that is set up in so many cases and peritonitis accounts for deaths following appendectomy in from 30 to 80 per cent of the fatalities.
This is based on the reports as submitted by various surgeons from all over the country at large. How reliable these figures are we can only decide after reading the article as submitted by the individual surgeon and under the conditions in which the operation took place and the kind of risk the patient was at the time of operation.

The removal of a gangrenous appendix can hardly be done except in the very terminal stages of the disease with beneficial results. If drainage is instituted and the acute process allowed to subside, then later go in and remove the organ. The condition of the patient is better and he is able to withstand such action and he or she is a much better operative risk. However, with a serious infection and the body having all it can possibly do to combat the acute process, the addition of shock and trauma along with the removal of the appendix is simply more than the defense of the body can handle. Then we may consider some of the after effects of such action. The pus may and usually does escape. This leads to the constant throwing out of new adhesions until the abscess reaches a great size. The adhesions then in turn place the patient's life in danger, a new danger of intestinal obstruction and he is further exposed to venous thrombosis, embolism and a generalized septicemia. Another article (46) says that 14,000 die every year in the United States from appendicitis complicated by peritonitis and this makes the death rate about 7 to 10 per cent. The pre-operative treatment of intravenous normal saline solution is advocated for all very sick patients. The McBurney incision is direct
approach to the abscess, drainage of the pus and removal of the appendix without danger of spreading the infection is better affording a method of prevention accidents and lowering mortality according to (32) and (34). The article goes on to say that with plenty of fluid and the use of morphine to quiet the patient, the free use of gastric lavage along with prompt diagnosis and early operation in appendicitis would tend to decrease the mortality to almost a vanishing point.

During the years 1900 to 1920 5,488 appendectomies were performed in Lanhenau Hospital in Philadelphia. Over the years there were 327 deaths or a mortality of 5 per cent. However in the hospital the mortality had a general lowering of the figures though at times there was an upward spurt which eventually showed a lowering later. In 1901 there were 135 cases, deaths however were only twenty six with a mortality rate of 19.2 per cent. This was when not so much was known about the troubles following the removal of the appendix. In 1920 there were 271 cases with a mortality of 13.6 per cent. The range stayed right about that figure but in 1905 the death rate rose sharply without any real cause or reason for so doing. That year the rate was above 13 per cent. Therefore for the first five years of operations over the period there were 1358 operations with 145 deaths with an average of about 11 per cent. How they get that figure I do not know as it is high according to the figures they gave. But to contrast that with the last five
years of this study, 1915 to 1920 the mortality fell to 4.2 per cent. The average length of hospitalization was from three to five weeks. The patients in this place came in from one to twenty-eight days after the onset of the trouble or after the first noticed attacks. In this list those who had later taken purgatives in any amounts or of any kind were always slower in mending and furthermore the mortality among those was always higher than among those who had not taken any purges. As regarding fecal fistulas if the cecum or ileum is directed away from the normal position or if there is induration and ulceration at the time of operation the fecal fistula is more likely to develop. In all cases cigaret drains seem to be of great value and especially those patients in which an abscess was seen. In this series the highest mortality followed sub-diaphramatic abscess or multiple abscesses.

Coming to a little later date we read of what Dr. John E. Summers (49) of our own school has to say in his article in the Nebraska State Medical Journal in which showing is made of 500,000 cases of appendicitis in Canada and the United States in one year with a death rate of 5 per cent or about 25,000 deaths in one year from this area. Therefore the number of deaths is increasing but the percentage has not actually gone up over the period of the ten years before. Dr. Summers says, "This death rate equals the combined death rate from ectopic
pregnancy, pyosalpinx, gallstones, pancreas, spleen and thyroid. It nearly equals the mortality rate from gastric and duodenal ulcer, intestinal obstruction and gallstones."

Deaver (23) whose article I have placed in my reading and in the bibliography, Dr. Summers says is to-day recognized as probably the most experienced and as safe a surgeon in the medical and surgical treatment of appendicitis as any man in this country or abroad. He explains that the use of purgatives as at one time being the correct thing to use but now he is strongly against any kind of purge. This I have found to be true in every article read by later authors. Dr. Mecrae late of Council Bluffs, Iowa, says "It is felt that the medical profession generally is more negligent and careless now in the early treatment of acute appendicitis than it was twenty years ago." Dr. Summers goes on to say that the best results of any treatment of appendicitis done by one man during the past twenty years are those of Dr. Le Grand Guerry of Columbia, South Carolina. The series on an unselected set of series was that of 2959 cases with only sixteen deaths—a mortality of 0.54. Dr. Guerry followed to a great extent those rules recommended by Ochsner. But too strict adherence to these rules is not to be recommended. Ochsner sometimes waited too long but on the other hand to start the active methods of Murphy too soon is bad so Dr. Summers advises a happy medium in the treatment of appendicitis and with experience in such matters it is best for the individual
operator to rely more and more on his own judgement. Dr. Summers says that in his contact with members of his profession and his experience as a teacher has given him proof of the apparent indifference to the seriousness of the disease, in the minds of students, hospital internes, young surgeons and some of their elders.

Dr. B. E. Davis (20) in a paper read before the annual meeting of the Nebraska State Medical Association, Lincoln, May 13, 1930, has the following statistics for the United States. In 1900 the number of deaths due to appendicitis was 9.7 per 100,000 of population. In 1910 the figure was 11.4 deaths per 100,000 population and in 1920 there were 13.4 deaths while in 1927 the figure had gone up to 15 deaths per 100,000 population. Therefore according to the report by Dr. Davis the number of deaths from appendicitis in the United States had increased from 1900 to 1927 by 54.6 per cent. He suggests that the increase has been steady and almost constant. The appalling thing with the situation according to him is the fact that there was seemingly nothing to combat such a situation. There has been this suggestion that the disease in greater incidence may be due to a greater virulence of the infection or it may be due to poorer management. On the other hand we might three groups that Dr. Davis offers to us as to where to place the blame for this high mortality.
1. The patient himself.
2. The physician first called.
3. The surgeon's responsibility in the case.

It has been mentioned that Dr. Summers had noted a decrease in the study and discussion of appendicitis and Dr. Davis says that of late years papers on appendicitis before medical societies have been chiefly conspicuous by their absence. This was not true thirty years ago and maybe that is one reason why the mortality is so high to-day. It is possible that the men treating this disease are not trained carefully and sufficiently to deal with this situation as we have it all over the country to-day. When to operate is questionable but Dr. Davis advocates operation in nearly every instance as soon as the case is clearly diagnosed, although he is not so sure that is right. He admits that that point is debatable.

The Ochsner treatment of watchful waiting however in many cases has been detrimental and even fatal (4) Ashhurst, a conservative man reports 247 complicated cases and of this number there were 210 with gangrene, perforation and peritonitis who were operated at once or as near at once as possible after being seen by the surgeon and there were only 10 deaths or a mortality of 4.8 per cent. Thirty-seven of the cases outside of the 210 were delayed and treated by the Ochsner method of waiting and the result was thirteen deaths and the mortality in that group was 35 per cent.
Therefore that brings up the question again of when to operate. We are not always able to tell just how far the disease has progressed even though it is known to almost the exact hour when the onset of symptoms showed itself. The abdomen can be opened and if deemed wise to remove the diseased organ or if pus is found at least drainage can be instituted and that process continued until such time as healing takes place or it is all right to go ahead and remove the appendix. Operative action as soon as possible seems to be the best in all cases taken as a whole. Therefore it is better to make the incision and be ready for removal or drainage or both and take the situation well in hand at the start rather than to wait until surgery is of no avail as far as any benefit is concerned.

Dr. Warnshuis (52) of Grand Rapids, Michigan has made one of the most exhaustive studies in recent years and has tabulated statistics from 35 hospitals in which 11,400 cases were involved. He divides the mortality (acute cases) in 5,736 cases at 4.23 per cent; the mortality in (chronic cases) 5,664 cases at 1.68 per cent and then for the whole lot of 11,400 cases he finds the mortality to be 2.9 per cent. This is over a period of eight years and eight states and the statistics taken from all of the states at the same stated time. Here again in his article he goes over the same precautions and the same conditions as formerly given in other articles. The differential diagnosis he feels is very important and he places more emphasis on that one point than do any of the other authors.
We must know the various types of symptoms which may simulate appendicitis in its various forms. The pre-operative action, the post-operative care and the technic at the time of operation all go in to make mortality of this disease either greater or lesser just according to the individual surgeon and the conditions under which he operates. Dr. Kolodny (37) of Sioux City, Iowa maintains that the mortality from appendectomy is steadily increasing not withstanding the amount of knowledge of the pathology and the treatment of appendicitis. However this rise in mortality has attracted the attention not only of the profession but even some of the laity. It seems that most of the work in the prevention of the mortality has been given to the laity in the form of advice of what to do or what not to do with the first onset of pain but very little has been given to the work of the physician. Again we are confronted with the one big factor which makes for high mortality—the delay in operation. By the time this delay has taken place the body defenses are weakened, the patient may have become somewhat dehydrated and the infection has spread until it becomes a suppurative affair and septaecemia is well established. Another factor which has been touched on before is the incompetency of the physicians in charge. Dr. Kolodny has found that the states with the largest mortality from appendicitis are the same states which have the smallest number of physicians per given area. Nevada with 846 square miles to each physician had a mortality of 31.1 per 100,000 of population.
Wyoming with 422 square miles to each physician had a mortality of 29.4. Montana with 292 square miles for each physician had a mortality of 26.4 (42). Colorado with an area of 58 square miles per each physician had a mortality of 25 per 100,000 of population (42). Then coming on down to the District of Columbia which has 32 physicians per square mile had a mortality in 1929 of 20.9 per 100,000 of population. Therefore we might say that it is just as much a responsibility of the public for the delay in operation as is the family physician (22). It is not the entirely ignorant patient who insists on delay in operation as he or she is generally so fearful and upset that they will follow any advice in an effort to get relief. It is the half-educated person or the person who has a smattering of "laity knowledge" who causes much of the delay. He has heard advice handed out on all sides from all kinds of people and from all kinds of sources. One person has told him one thing as being the correct thing to do while another person is just sure that something else is the only remedy or else some certain surgeon is the only one to have and let the operation go if that one man cannot be obtained. So he is trying to follow his own ideas and the advice of all and the family doctor or the surgeon in charge has not only to treat the disease but he must break through certain barriers and build new ideas and conceptions and as it were almost re-educate the patient. The half-educated patient thinks he has a "spell" and that it can be worked off. However in time he finds to his dismay and regret
and many times to his friends' and relatives' sorrow that he has waited too long. The "spell" cannot be "worked off" by the use of ice packs, hot water bottles, salts or castor oil. There then in medical situations we see that "a little knowledge is a dangerous thing". Sometimes is a very dangerous thing or else we would not see such high death rates. Now when the patient is not at fault it can be said that the physician is most always at the bottom of the delay. Maybe he can not or did not make a correct diagnosis or he may say that the delay is due to the expectant treatment he believes in or he may tell the patient and the family that he is employing conservative methods of treatment as the best thing to do (38). Then after a long delay and in waiting the doctor finds that he is up against a perforated appendix and a severe peritonitis he must justify himself in some way. He says that he has been acting on the authority and following out the treatment as given by Ochsner but failing to recognize all that Ochsner has advocated. Ochsner suggested his expectant treatment only in cases of advanced peritonitis that resulted from appendicitis. In studying these cases all of those factors must be taken into consideration.

In studying the mortality from appendicitis in the leading cities of the United States we see a great range or variance of from 59 to 1.9 per 100,000 of population. The three cities in the United States with the highest mortality from appendicitis
in 1930 according to the figures at hand are Oak Park, Illinois 59 per 100,000 population. Lexington Kentucky, 58.9 per 100,000 population and Sioux City, Iowa 54.2 per 100,000. The cities with the lowest mortality were Fresno, California 1.9 per 100,000. Orange, New Jersey 2.8 and Akron, Ohio had 3.5 per 100,000 population. The mortality rate following appendectomy is far in excess of that in any other civilized country. For example compared with England and Wales (35) they have a mortality of 7.3 per 100,000 population while Scotland has 9 per 100,000. Germany has 9 per 100,000 with Prussia at 6.8 while Italy has only 3.7 per 100,000. The same is true when we compare larger cities in our country and larger cities of foreign countries. Chicago had a mortality in 1930 of 20 per 100,000 population. Detroit had 20.2 per 100,000, New York City had 16 per 100,000, Philadelphia 14.1 per 100,000. Mexico City had a mortality of 9.9 per 100,000. Tokyo had 6 per 100,000 and Moscow had 5.2 per 100,000. But we cannot tell for sure just how reliable those figures are. I will give what we feel are quite reliable figures for Canada and we find there a mortality that closely approaches ours. 22.9 per 100,000 in Alberta down to as low as 9.1 per 100,000 in Nova Scotia. In other parts of the world the rate is surely less even in the tropics and subtropics the mortality is less but on the other hand the incidence is not so great either. Dr. Robert T. Morris in a quotation says, "Why should the death rate from appendicitis
per hundred thousand population be 2.9 in Italy from 1921 to 1928 but in our own United States a bad 13 per 100,000 in 1918 and even worse to 18 in 1930?" In Italy the surgical work for appendicitis is in the hands of masters, while in our United States we have masters equally fine but the majority of the appendectomies are not in the hands of these men. Formerly we had a death rate in some of the more protected classes as low as two or three per cent but they were cared for by master surgeons. However now the death rate in the same class of patients has jumped to as high as fifteen per cent in some cases. One thing that is encouraging is the fact that the mortality shows a drop as the experience of the surgeon increases in his work with appendicitis. This is particularly true from the records taken from twenty-seven hospitals in Philadelphia (12). A survey of one hospital in Philadelphia shows one surgeon to have a mortality rate of 20 per cent while another surgeon working in the same hospital has a mortality rate of 3.3 per cent. (27). Such conditions will of course cause all thinking men of both the laity and the profession to get busy and demand better care. The one thing that applies to the laity is the fact that they do not know very much about these except in a few cases and then only in the local locality. There will be an increased demand for better trained men and men with more experience to carry on the surgical work in appendicitis.
The profession as well as the laity will demand better diagnoses and men with better technique at the operating table. The operation in most cases follows the diagnosis of the condition and so when in the judgement of the attending physician it is deemed wise and necessary to operate both laity and profession will demand better trained and more highly skilled workers.

While the public is responsible for a share of the deaths from appendicitis because of delay, yet the incompetency of the surgeon in charge is responsible for the balance of the mortality. The number of men who have had little or no training and whose technique is rotten, seems to be increasing when it comes to doing an appendectomy. But even far far worse than that is the poor surgical judgement which is shown both before and after operation. In some sections of the country this increase is great and so due that factor alone we can see that this would lead to an increase in mortality following operation. (19). We review another series of cases and we find an overlap in this diagnosis and another overlap in another direction. So many men are ever ready to give their ideas as to why this mortality rate is seemingly on the increase but few if any have any worthy offering to make as a suggestion to combat this trend. None of these suggestions if offered have been carried out successfully the country over in and effort to drop the mortality. We do have to admit however that due to strenuous efforts on the part of staffs in various
hospitals over the entire nation that in these localized places the mortality has dropped, but if we may use the example of our own state and also of our own hospital we find that the mortality rate in our University hospital is less following appendectomy than is it outstate and this is in spite of the fact that many in coming patients to the University hospital have traveled a great distance and many are not seen until several days after the onset of the symptoms. Therefore this distressing situation is brought right to us here at home.

In some parts of the country the surgeons no matter how poorly equipped are willing to tackle any appendectomy with two results. He may be fortunate a few times and "get by" in great style or he may have such a success that he will lose no cases at all for a long period of time and he begins to think that he is a master surgeon in this line. Later he may run into his down fall as he becomes more careless and eventually the mortality jinx hits him. He will have a series of cases in which he may have a high mortality but it is not until he has lost three, four or five cases does he awaken to the fact that something is very decidedly wrong. But in the meantime he has lost his patients. On the other hand even though he may not lose the patient yet this type of man is bad for the patient. The surgeon may do the operation and while he may not have a high mortality the morbidity is high and sooner or later the mortality can't help but be high.
In an endeavor to find the cause of the great increase in the mortality of acute appendicitis which amounted to 22.3 per cent in the United States during the ten year period 1913 to 1923 and 18 per cent in Philadelphia during the same period, Dr. Cairn began a survey of the hospitals. He checked the 27 hospitals which have been mentioned before and studied the clinical records of 5,121 patients. An attempt was made to secure age, sex, time in hospital and who the diagnosing physician was in charge of the given case. He checked the lists of the surgeons who operated and he studied the part played by the laxative entering into the picture before hospitalization and in fact every thing that would be of importance in making such a survey. Only the positive statements were taken and where there was any doubt of any nature the study was not considered reliable or worthy of notice and therefore not included in this list of series. This was done because there may be a tendency on the part of many people to regard statistics as just so much of figures to be manipulated to support or refute a contention. To some extent I believe that is right. I can't believe that statistics in themselves are of definite value unless they are studied critically and some idea gained as to the conditions under which they are gotten. But on another condition many large business houses and huge industries base their business balance as to profit or loss according to various reports and statistics. Life insurance companies are very inclined to relieve on statistics heavily and giving
to them the utmost value under the circumstances. I do not think that to give great masses of figures is so essential as it is merely reading dry figures and are really not of consequence. However bases of comparison are worth something and as we study them from the standpoint of comparison—one hospital with another, one city with another city and one part of the country with another part of the country we do so with the idea of gaining a broader viewpoint of the situation as a whole. Dr. Cairn does not offer anything more than has already been suggested by other authors. He was only trying to get some idea and make comparisons with other parts of the country and the conditions where surgeons work not only in Philadelphia but over the country as a whole.

Most people when thinking of an appendectomy think of it most optimistically. This is true of both the laity and also the profession. This is due in some measure to the fact that not enough attention is paid to the mortality and also that not enough is said concerning the pre-operative period. In some few hospitals a few master surgeons will have a low mortality. In fact in some cases it will be almost nil. As said before the mortality decreases with the experience of the surgeon and as he meets more and more of the abnormal appendices as to anatomical location and pathology he is better able to cope with the situation and the outcome will be much better. There is no disorder of the human body in which surgical judgement influences the outcome so frequently or so markedly as in general peritonitis.
Hospital mortality on the other hand may be improperly placed. The death may occur in the hospital but the factors that entered into the picture before the patient was admitted to the hospital may be the real cause of that individual death. Delay in operation or even before that we see delay in calling for a physician. In the meantime the patient may have taken a large amount of laxative or just preceding the attack the patient may have eaten some one or some several kinds of food which results in an upset stomach and the disorder is then passed down the intestinal tract. After the patient enters the hospital the greatest factor influencing mortality is the management of general peritonitis. (5), (38). We may spend a little time upon the influence of delay as it affects the mortality. There is in many cases a belief that if the patient is operated on early that the chances for complete recovery are 100%. This is not true. Dr. Bower (12) says that even under the best conditions one patient in every thirty-nine die even if operation is performed early such as within the first 24 hours. Then we go down the scale of time comparisons and find that one death in eighteen for every case operated on in from 36 to 48 hours. Then coming down to seventy hours or longer it is one death in every six to eight cases but of course by this time in so many cases gangrene has set in. Without exception patients developing perforation with fulminating peritonitis before twelve hours have been given a laxative and of 160 patients in a series of deaths, 131 of this group had been
given a laxative. They all developed peritonitis and so Dr. Bower decides that a patient who has been given a laxative and then consequently develops paritonitis, has but one chance in seven of recovery. Just as side line on this subject Dr. Bower (12) finds that deaths in men were higher than women following appendectomy. He also found that the greatest incidence of appendicitis is between the ages of 11 and 20 but that the mortality is nearly at its lowest at that age.

In order to evaluate the statistics or the treatment off appendicitis we must rule out of the count all cases of operation where the appendix shows but little or no pathology. A large number of the operations belong to this class. So many times operations are performed with a wrong diagnosis but the appendix is blamed (6). Dr. Poynter of our school made a statement which cause me to do a little thinking in this connection. He was inclined to believe that if all cases of appendicitis and those diagnosed as such had never been touched with a knife, that the total number of deaths would have been less than they are to-day following appendectomy. He was not saying of course that there would be no deaths but just making a comparison as he viewed the conditions over a period of years. At first I thought that was a pretty strong statement but after turning it over in my mind and doing some reading on the matter I am pretty well convinced that what he said may be far nearer the truth if we could have seen it worked out, than what people would think.
Therefore again we should not place too much faith on just figures or statistics and this is borne out by many men. (6), (5), (23), (28) and (46).

Dr. Basham (6) says that he does not mean to imply that waiting should be the rule until suppuration or that operation should not be done early. He feels that suppuration perforation and gangrene with leakage and destruction of tissue are the end results of neglected appendices but in many cases he has felt that many appendectomies were done that were not indicated. Success and judgement of the surgeon depends on close study of the types of abnormality as he finds them from time to time. Many of the young surgeons in an effort to show good technique and ability forget the part that good judgement plays. They have lost sight of the human side of the problem and the patient as an individual patient is pushed out of the picture. Dr. Basham thinks that in the simple uncomplicated case of appendicitis there is usually recovery no matter who does the operation, but he says that there is no field of surgery where knowledge, surgical acumen, experience and technique count for so much as in the treatment of appendicitis. However I have a doubt in my mind that we can follow the first part of that statement. It has been shown in some cases that regardless of the maximum conditions for surgery, the best physicians at hand and everything at the surgeon's disposal to bring a patient through with no interrupted, yet some of these patients will go right on out and it is just a case that cannot be explained.
Dr. Lowe shows that the death rate in the state of Missouri has been actually on the increase since 1924. In connection with Wilkie (56) Dr. Lowe (38) shows that in spite of England's death rate in appendicitis being lower than in the United States the percentage is high. Why this two men should discuss England and Missouri together I cannot entirely understand. In both places however the death rate has not dropped for twenty years while in Missouri it has actually gone up. Dr. Lowe places the number of deaths very high. He claims that now here in the United States that there are 35,000 deaths yearly from appendicitis. This applies to the last two or three years of available figures. This is in contrast to the statements made by other authors. (19), (21) and (48). The varying of the mortality was from 1 to 21 per cent and this compares well with the varying of mortality in the state of Michigan as far as the wide range is concerned for just one single state. When death has occurred from appendicitis some one has made a mistake, It may be in the patient himself or it may be his family or we may have to come back to the family physician again. In looking over the suggestions for errors I find a grouping such as this below.

1. The patient treats himself or his family by home remedies. This of course is delay for which the patient or his family is to blame.

2. When the physician is called he fails to recognize the condition and start the proper treatment.

3. When when once diagnosed the case is not handled
3. (cont) properly as to the pre-operative care and also the post-operative care. Coming back to the laity again, we wonder why people will delay in calling their physician in cases of appendicitis.

The average physician does not stress the importance of calling for help when symptoms of appendicitis appear (17). The people in the home and at their work for the most part are not aware of the seriousness of the disease. Who then is responsible? The man in charge of patients daily and who should warn against this disease must be somewhat to blame. When patients come to the office to see the doctor if there is a suggestion upon which he can work he should impress upon the minds of his patients the dangers in delay and thus by means of an educational program go a long way in correcting this high death rate from appendicitis.

In England the mortality is not as high in proportion as here as shown before. But over there they are of the same opinion as the American physicians. I find that they agree well in several points as to ways to reduce this mortality (45), (35), (1).

1. The first reason and held in common by all is the fact that the patients do not summon the physician in time.
2. They depend too much on textbook descriptions.
   and do not relieve on their own judgment and experience as much as they should, especially when they have seen so many atypical cases.
3. Atypical symptoms and abnormal anatomical positions will tend to make differential diagnosis difficult.
Dr. Warren (51) in Lancet goes on to give some of the complications as he sees them across the water. He places factors such as below as affecting the mortality. The period of infection and the period of operation, the age of the patient, the sex, the accidental complications and the severity of the infection and the natural complications. Treatment he feels plays a very big part both before and after operation. The mortality in the British Isles is close to five per cent according to Dr. Warren's figures. Therefore these figures compare favorably with those in our country. The one difference is in the fact that those who do operate over in the British Isles for the most part are masters at their work. When it comes to a matter for the time selected for operation again it is not a matter of actual hours or days but rather the progress the disease has made since the onset.

Some cases will be nearer to peritonitis at the end of 24 hours than will others at the end of 72 hours. For example, Dr. Warren (57) gave a case of which he was called by the resident doctor to see a child who had just come into the hospital a short time before. The resident said that a few hours before he thought the child had an attack of appendicitis but right then it seemed well. Dr. Warren examined the child, a girl of five years, and found no outward signs of appendicitis. However they operated and found a gangrenous appendix. The child made a rapid recovery but waiting in that case probably would have resulted in a fatal termination. That was a very abnormal case and those are just
the types of cases which will puzzle and mislead even the best of surgeons and physicians. It is from this type of abnormal cases that many of the fatalities come as the operation is delayed too long.

Woodhall (57) in his analysis of acute appendicitis has tried to determine as fast possible the factors responsible for deaths in his series of cases. He was also interested in determining if there was any relationship in morbidity and mortality to the methods of handling the cases. He studied only cases in children under 12 years of age. The group showing the most cases for any given age was the ten year old group. The earliest cases in this series occurred in children two years of age. This series contained 295 cases all told and the deaths were 22 or a percentage of 7.5. Eleven cases were carried along on the Ochsner treatment of palliative measures and watchful waiting. More than half of the cases had been in pain over 36 hours before seen by a surgeon. In the case of children the morbidity and the mortality both increase with the elapse of time. After 60 hours of sickness before being seen by a surgeon the mortality was 27.8 per cent. Therefore we find the same factors responsible in the deaths of the children as well as the older cases. Of the 22 deaths that occurred 7 of the children had been put on the Ochsner treatment.
Therefore it seemed that delay in these cases was worse than where surgery was given at once or as soon as possible. In looking over the 22 deaths it was felt by the author that some of the children could have been saved. In 2 cases there was a definite history that the family doctor did not seek surgical aid when it first should have been sought. In one case an error in technique might have been the reason, while in 5 cases the surgical judgement of the operator might have been a determining factor.

Dr. C. R. Davis (21) making a study of cases under his close observation had gone over figures as given him by Dr. Warnshuis, Dr. Deaver and Dr. C. E. Black. All of these are included in my bibliography. He gives figures for comparison in a series of 951 consecutive cases. They covered a period of 12 years. There were 32 deaths with the mortality rate of 3.36 per cent. Where he considered general peritonitis alone he found that the rate was highest in the group going as high as 57.14 per cent. It was also noted that in the undrained cases the mortality was only .69 per cent but that the mortality in the drained cases was 11.17 per cent. He concluded that if this was to changed that he must either operate upon them before drainage is necessary or else change the manner in which the general peritonitis was to be handled. He prefers to get all of his patients the first day and he tells his patients that the proper time for the removal
of the appendix is the first day of the first attack. The lowering of mortality is a problem that though there are many suggestions yet seemingly in spite of all that is done there is almost not a distinct noticeable change. In an effort to lower the death rate we must think of the patient or the patient to be. There should be a campaign to tell all the dangers in delay and to tell why action must be taken early. (32)

A survey of the Canadian hospitals shows a figure almost the same as in our own hospitals. They have the same factors to consider and delay seems to be their big problem up there. In the more sparsely settled parts of the Canadian backwoods and farm lands where it is hard to get a physician at once the mortality is found to be around 25 per cent. However in the best class hospitals the mortality is down to around four per cent. Here the biggest factor in the cause of death is as in the United States-- peritonitis. In the failure to save all cases following operation for relief from chronic or recurrent appendicitis the following factors are to be considered (46)-- An incorrect diagnosis. Displacement of the abdominal contents and pain being located at unusual sites. Then indifference following operation seemed to be noticed very much in some of the surgeons. "Oh well this is just a case of simple chronic appendicitis and there is no need to worry" This one thing alone was repeatedly seen as a source of morbidity and also mortality.
Figures of the Metropolitan Life Insurance Company show their mortality from appendicitis alone have increased from 10.9 per 100,000 population in 1911 to 13.7 per 100,000 in 1928. Therefore they feel that according to their statistics that in spite of the fact that its pathology, symptoms and treatment are well established, the mortality has actually during the past twenty years. (16). The Prudential Insurance Company in a study of the mortality from appendicitis in sixty cities shows the death rate per 100,000 has increased from 13.3 per cent in 1910 to 17.6 per cent in 1925. In the United States in 1926 the deaths from appendicitis were 17,335 and from general peritonitis 12,655. Therefore it must be concluded that there is a rising mortality taking the country as a whole. We also must recognize the fact that there is an increase in the incidence of the disease. Between the ages of 10 and 30 they show that sixty to seventy per cent of the cases occur at that time. Common causes of delay are diagnosis of "intestinal flu" and "food poisoning". Up to six days or seven days duration of the disease several of the hospitals have found the death rate increases in proportion to the length of time. However after the sixth day there seems to be a localized condition and the mortality rate drops considerably but the hospital stay is considerably lengthened. Appendectomy and that early is the only treatment for acute appendicitis and surgical treatment and management is the only treatment for its complications.
According to the very latest reports I could obtain which are listed in a March 17, 1934 issue of J. A. M.A. I want to list what Dr. John O. Bower (10) has to say with regard to progress made in the campaign for reduction of mortality in Philadelphia. In 1931 the decrease in mortality was 0.42. This was due to a large measure because surgeons were improving in the management of spreading peritonitis. During 1932 taking the words just as Dr. Bower gave them he has found six factors which help to diminish the mortality.

1. A marked increase in the number of cases over the preceding years.
2. Earlier hospitalization.
3. A diminished number of cases of peritonitis.
4. A diminished number of cases of spreading peritonitis.
5. An improvement in the management of spreading peritonitis by the surgeons. (Philadelphia surgeons)

Dr. Bower (10) reed that if this campaign is conducted with increasing intensity against delay in hospitalization and the abuses of laxatives that in 1940 spreading peritonitis will be as rare in the Philadelphia hospitals as are the cases of typhoid fever at the present time.

In 1930 the number of patients having peritonitis was 20.2 per cent of the appendicitis cases admitted.
In 1932 this percentage had dropped to 15.9. However he says that the diminished mortality was due to the fact that there was an actual decrease in the number of patients admitted to the various hospitals. Therefore while there is a campaign to fight this high mortality and there has been a lessening in the cases of peritonitis, yet the work of lowering the mortality following appendectomy is barely begun and there is a long way to go to bring this condition under better control. Only by strict observance of early diagnosis, early operation, sound surgical judgement and masterful surgical technique can this control be brought about and the mortality rate actually lowered over the country as a whole.
CONCLUSION

1. Peritonitis is the greatest factor to-day in the cause of high mortality.

2. Delay--both in diagnosis and surgical removal is responsible for high mortality.

3. Cases where a laxative is used before operation are almost certain to have post-operative peritonitis.

4. Too many incompetent surgeons are doing appendectomies regardless of training both in technique and surgical judgement. They should either be better trained or these cases should be left to the master surgeons.

5. Incidence of appendicitis for the country as a whole is increasing and the mortality rate is actually on the increase as far as the total number of deaths yearly that are reported.

6. The mortality has been cut down in our better hospitals.

7. The mortality for a state or large given area is the greatest where there are the fewest physicians per given area of square miles.

8. Early removal of the appendix is best as mortality rises almost in proportion to time of delay.
9. Campaigns should be conducted in order that both the laity and the profession be better acquainted with the dangers of appendicitis.

10. Laity co-operation is essential in that they should be instructed to call their family physician for a persistent abdominal pain.

11. Our own United States has the highest mortality record following appendectomy of any of the civilized countries according to available statistics.

12. The mortality percentage taken for the country as a whole is for the most part around 5 per cent but shows a variation up to 10 per cent over some areas.

13. We have made very little progress within the past twenty years as far as definite lowering of the death rate from appendicitis.

14. This condition is one of the greatest sources of debate and consternation facing our hospital staffs and the operating surgeons at the present time.
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