Leucocyte counts in eighty-three cases of appendicitis : the limitations of leucocytosis as an indication for laparotomy / by Herbert French.

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LEUCOCYTE COUNTS IN EIGHTY-THREE CASES OF APPENDICITIS:

THE LIMITATIONS OF LEUCOCYTOSIS AS AN INDICATION FOR LAPAROTOMY

BY

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Introduction.

From the surgical point of view cases of acute appendicitis resolve themselves into three groups, namely, those which require no operative measures during the acute stage, those which need evacuation of pus from a local abscess, and those which require an immediate laparotomy for general peritonitis.

In deciding whether a patient may be safely left for a time without operation, every symptom and sign needs careful attention: the distribution of the pain, whether local or general; the vomiting; the extent of the hyper-

æsthesia; the presence or absence of a swelling; the mobility or the rigidity of the abdominal wall; the distension of the bowel or the reverse; the facies of the patient; the condition of the tongue, whether moist or dry; the character of the respirations; the temperature; and the pulse-rate.

Even, however, when all the above points have been considered, it is sometimes impossible to decide whether or not pus be present, needing to be let out. The patient may seem fit to leave, when shortly afterwards a sudden increase in the pulse-rate, more general tenderness and rigidity, with absence of abdominal respiratory movements, indicate a rupture of an abscess into the general peritoneal cavity. The physician then regrets he had not some further clue leading him to diagnose the presence of pus earlier. On the other hand, most surgeons prefer an acute simple case, without pus, to be left until the inflammation has subsided, and then to perform appendicectomy during convalescence.

It is as such a further clue in diagnosing pus that leucocyte counts have been found serviceable.

General Results.

There are several papers upon the subject, the more interesting of which are mentioned at the end of this monograph; but in many published cases the authors attribute too great an importance to leucocytosis as a sign for operation. A new discovery is apt to attract too much attention to itself, with the result that too much is expected of it. The best way to correct this is to record the finding in a considerable number of cases; and the present paper is a contribution to that record, from eighty-three consecutive cases at Guy's Hospital. It is remarkable what great variability they show.

Before discussing the cases themselves, it cannot be too strongly pointed out that a given leucocytosis in appendicitis is not by itself a definite proof either of pus

or the reverse. Leucocytosis is not a "penny-in-the-slot" sign. A leucocytosis of 25,000 or more may occur in a patient who recovers completely without operation, and pus may need evacuation in a patient whose leucocytes never exceed 15,000. The leucocytosis must be taken into account along with all the other clinical indications. The pulse-rate by itself will not decide whether pus is to be let out or not, neither will the leucocytosis; but just as the pulse-rate is of very great assistance in deciding when an operation should be performed in some cases, so may the leucocytosis be of similar assistance in others. It is one amongst many valuable clinical signs in such conditions, but cannot be regarded as of more importance than the rest.

Many cases of appendicitis are clinically such that, whatever the leucocytes might show, the other signs would indicate the need for operation. Others, on the other hand, are such that pulse-rate, temperature, abdominal and general conditions leave it still uncertain whether operation should be performed or not.

Earlier observers held that the absolute leucocyte count was all-important. For instance, Wassermann (9) and Da Costa (5) both conclude that pus is always present when the leucocytes exceed 20,000. This is certainly not so, or at least the patient sometimes recovers without operation even when the leucocytes exceed 30,000 (Cases 21, 43, 44). Cazin and Gros (2) lay much more stress upon a rising leucocyte count, and give the following examples:

No pus.			Pus found.
25,800	...	...	8,350
26,600	...	...	10,200
24,000	...	...	26,250
16,400	...	...	29,000
8,000	...	...	34,000
—	...	...	39,000

A leucocyte count rising with pus accumulation is well

exemplified by Case 66, and several others also show it; whereas none of those patients in whom no pus was present showed a similar continued rise. Yet it cannot be laid down as an infallible rule that "when pus is present there is a rising count," for pus may be present with a falling count, as in Case 60, or with one which remains almost stationary, as in Case 73. A good example of a falling count indicating resolution, though the symptoms were for a time grave, is Case 81. One can only say that a rising leucocytosis is a sign that pus is probably present, and that it seems to have a greater diagnostic value than the mere magnitude of the total count.

Four Clinical Groups.

With a view to laying still greater stress upon the great variability in leucocytosis in appendicular conditions which appear otherwise quite similar, the present eighty-three cases have been classed into the four following groups:

Leucotyte Changes in Each.

Group I.

In these cases the onset was variable, sometimes sudden, sometimes gradual; vomiting usually occurred during the first twenty-four hours, but seldom after; there was usually constipation; the signs were all local to the right iliac fossa, with pain, hyperæsthesia, possibly rigidity; but without tumour. The patients all became convalescent without operation.

In three of these (Cases 11, 15, and 19) an operation during convalescence showed adhesions round the appendix, without pus. In the remainder no operation was performed, and therefore no proof that pus was absent can be adduced. They became quite well apparently, and no operation was needed.

In most of them there was little or no leucocytosis. In

more than two-thirds the leucocytes did not exceed 15,000, and this is what one would expect. But in three cases the leucocytes exceeded 20,000, in one even reaching 31,000, without any other clinical evidence of pus. This is contrary to expectation, but is an important point, showing, as it does, that the total leucocyte count must be very high before it, by itself, can be regarded as an absolute indication for operation.

Group II.

In these cases the clinical signs were again local, and similar to those of Group I, but with this difference: a definite tumour could be felt in all of them. In many of these the question of operation was frequently discussed, but in all there was spontaneous resolution of the swelling.

In this group again it is not possible to say absolutely that no pus was present. In Cases 31 and 32 an operation was performed after convalescence, and adhesions round the appendix, without pus, were found. In the remainder no operation was performed. In some there may have been an abscess which ruptured into the bowel, but, as far as possible, those cases in which rapid subsidence of a tumour suggested the rupture of an abscess into the colon have been excluded from this group, and included in the next. It is possible that appendicular pus may be spontaneously absorbed, as is known to be the case occasionally with empyemata; and this may have happened in some of these patients. But the point is that spontaneous resolution of the tumour, without clinical evidence of the presence of pus, occurred in all, and in none was there an operation during the acute stage.

Again there are the greatest variations in the leucocytes. The maximum (31,000) and the minimum (8,300) are almost identical with those in the first group. In more than a third the leucocytes exceeded 20,000, in one case reaching 31,000, and yet no operation was called for. It is noteworthy that where successive counts were made

the numbers fell in all cases except No. 38, where there is a possibility that an abscess was present at first, but spontaneously ruptured into the bowel.

Group III.

In these patients the signs were again all local to the right iliac fossa, as in the two previous groups; and there was a definite tumour. The difference between these and the cases in Group II is that pus was proved to be present, either by its evacuation at an operation, or by the sudden disappearance of a large tumour, clinically suggesting rupture of an abscess into the bowel.

It will be seen that in a quarter of these cases there was nothing that could be called a leucocytosis at all. In three quarters the figures did not exceed the maximum found in Groups I and II. In the remaining quarter there was so great a rise (34,000 to 56,000) that any case amongst the first two groups is quite eclipsed. If any rule could be laid down as to the minimum leucocytosis which, on one count, indicates pus with any certainty, the figure could not be less than 35,000; and when statistics from other hospitals are published it may prove to be higher still.

On the other hand, as has been already pointed out, it is from cases in this group that the value of a "rising" leucocyte count may be gathered. Case 66 is a good example; Cases 64, 65, and 68 are others, no similar cases occurring amongst Groups I and II. Unfortunately, all the earlier cases were observed before this point was realised; more evidence is needed, and in due course more cases will be recorded. Case 65 is particularly interesting, in that it shows a fall after the appendicular pus was evacuated, and then a rise again as an empyema was collecting. It was the rise which was important here, not the absolute count, which was small.

It has been stated that no increase of leucocytes occurs when pus is enclosed in an old, thick-walled abscess

cavity. This seems not improbable, but there is no means of drawing definite conclusions on this point from the present cases. All that can be said is that chronicity is by no means a bar to leucocytosis. In Cases 53 and 54 the patient had been ill more than a month, and yet there was a leucocytosis. Naturally it will be urged that pus had not perhaps been present all the time. That is quite possible, and the condition of the abscess-wall has not been recorded.

Case 70 is of interest, being particularly difficult to diagnose. In the first place the trouble was in the *left* iliac fossa, the cæcum being transposed to that side; and secondly, the abscess cavity was resonant owing to gas produced by the *Bacillus coli communis*. Neither pulse nor temperature nor general condition made it certain that pus was present, but the leucocytes were 56,750, and helped to turn the scale in favour of operation.

Group IV.

These were cases of appendicitis with general peritonitis; the appendix was either primarily gangrenous, or was bathed in an abscess which had burst into the peritoneum. The signs were no longer local to the right iliac fossa, but general all over the abdomen. All the patients were operated upon; half died, half were cured. Some of the cases were obvious, others less easy of diagnosis. It is well known how deceptive the signs may be owing to absence of pain or tenderness, to absence of a clear history pointing to the primary seat of the mischief, or to the possibility of symptoms being masked by opium given to relieve some previous pain.

Few patients belonging to this group have had their leucocytes counted. Most come into the hospital so obviously ill that laparotomy is performed at once. Of those cases which have been counted, half show 30,000 leucocytes or more. This is higher than the figures usually obtained; more often there is no leucocytosis, as in

the remaining half, and this is usually attributed to the virulence of the infection. Leucocytosis is thought to depend on chemiotaxis; perhaps in a mild case there is a small dose of toxin, the chemiotactic effect on the leucocytes is slight, and they do not increase; in a severe case there may be a large dose of toxin, the chemiotactic effect may be greater, and the leucocytes increase; the dose of toxin may apparently be great enough, even with non-purulent inflammation of the appendix, to cause a leucocytosis; and finally, it seems that a very virulent toxin, as in a bad case of acute appendicitis, may prevent the leucocytes from increasing at all. Perhaps the number of leucocytes may thus afford a measure of the virulence of an attack, or of the lack of reacting-power in the patient; but this is theoretical.

As a diagnostic sign of acute peritonitis the leucocytes are not to be relied upon. In this respect they may be compared to the temperature, which may be up, or may be down, or may be normal. In diagnosing general peritonitis far more stress must be laid upon the pulse-rate, the persistent sickness, the abdominal rigidity and immobility, and the facies Hippocratica, than upon either the leucocytes or the temperature.

Odd Cases.

Without making a fifth group a few additional cases have been placed by themselves because they did not coincide with any of the four main groups.

In four of these (Cases 77 to 80) suppurative pylephlebitis was present, but was not diagnosed during life. In one only was the leucocytosis marked.

Cases 82 and 83 are examples of difficulties in diagnosing pus; the former, because it lay behind the cæcum, the latter, because the trouble began in the left iliac fossa instead of in the right, the cæcum being transposed. In each of these the leucocytes reached 25,000, suggesting, but by no means proving, pus.

Sex and Age.

It might be thought that sex or age might have some definite influence on the leucocytosis. None such can be deduced from an examination of the eighty-three cases as a whole, though it is a curious coincidence that the maximum counts in each of the groups occurred in males.

Comparison with the Results of Others.

A very full analysis of a similar group of cases has been published by Da Costa (5) in America, and it is interesting to compare his results with ours. The following is his table for 118 cases:

Da Costa's Summary.

Leucocytes.	Simple cases.		All pus cases.	
	Acute.	Chronic.	Acute.	Chronic.
Over 50,000	—	—	1	—
40,000 to 50,000	—	—	0	—
35,000 to 40,000	—	—	2	—
30,000 to 35,000	—	—	0	—
25,000 to 30,000	—	—	3	—
20,000 to 25,000	—	—	14	—
15,000 to 20,000	4	—	30	—
10,000 to 15,000	2	9	19	3
5,000 to 10,000	8	9	7	1
Below 5,000	4	2	—	—
Highest	17,000	15,000	58,500	14,600
Average	9,124	9,190	17,718	8,800
Lowest	1,600	2,400	6,000	12,425

The following is a similar table for the present eighty-three cases:

Cases observed by the Author.

Leucocytes.	Clinically no pus.		Pus present.		General peritonitis.
	Acute (under 1 week).	Chronic (over 1 week).	Acute (under 1 week).	Chronic (over 1 week).	
Over 50,000	—	—	—	1	—
40,000 to 50,000	—	—	1	1	1
35,000 to 40,000	—	—	2	1	1
30,000 to 35,000	2	1	—	1	—
25,000 to 30,000	1	3	1	2	1
20,000 to 25,000	3	5	1	4	2
15,000 to 20,000	3	1	2	4	1
10,000 to 15,000	10	5	3	1	4
5,000 to 10,000	5	6	1	1	1
Below 5,000	—	—	—	—	—
Total cases	24	21	11	16	11
Highest	31,000	31,600	49,000	56,750	41,000
Average	14,165	16,885	23,068	25,739	20,608
Lowest	6,875	8,300	7,500	9,500	7,128

It will be seen that whereas Da Costa concludes any leucocyte increase to over 20,000 to mean pus, the author cannot draw the same conclusion from less than 32,000 leucocytes.

The maximum, the minimum, and the average of the author's "simple" cases are all greater than are those of Da Costa's.

The maximum and the mimimum of the cases with pus are similar in the two tables; but the average is higher in the author's cases than it is in Da Costa's. The latter, however, includes his acute peritonitis cases along with those where the pus was local, a fact which would probably bring down the average of his leucoyte counts.

The Differential Leucocyte Count.

It has been suggested that a differential leucocyte count accompanying the count of total leucocytes may afford

further valuable means of diagnosing latent pus. In purulent affections there is said to be a relative increase of the polymorphonucleated cells to 85 per cent. or even 90 per cent., in place of the normal 65 per cent. Unfortunately this investigation was not carried out in the present instance, except in Case 81. Here the polymorphonucleated cells reached 86 per cent., but the patient got quite well without an operation. Pus, if present at all, must have been absorbed, or have ruptured into the bowel, and there was no proof of either.

Da Costa (5) states that he made differential leucocyte counts on several cases, but found them useless. Longridge (8) on the other hand, publishing twenty cases from St. George's Hospital, gives differential counts in which polymorphonucleated cells were over 80 per cent. when pus was present, and were usually under 60 per cent. when pus was absent. Further investigation is needed on this point.

Diagnosis from other Conditions.

The present paper has dealt exclusively with leucocyte counts in cases where appendicitis is the certain diagnosis. There is another aspect of the question, however. The leucocytes may assist the diagnosis of appendicitis from other things. Without enlarging upon this, mention may be made of cases of appendicitis simulating typhoid fever with abdominal symptoms. At least a few cases of appendicitis have presented symptoms so obscure that typhoid fever has been diagnosed. But in the latter the leucocytes are rather diminished than increased; a leucocytosis of 15,000 has before now served to exclude typhoid fever and suggest appendicitis.

In cases of intestinal strangulation, it is said, there is little or no leucocytosis. Not infrequently difficulties of diagnosis between obstruction and appendicitis have arisen; in such cases, the leucocytes may help to solve the difficulty.

To Conclude.

The value of leucocytosis in relegating a given case of appendicitis to its proper group, and in deciding whether an operation should be performed or not, is apt to be overrated. Its value, judged from the present cases, is even less than that deduced by other recent observers from the figures they have found. Many cases with 20,000 leucocytes have resolved spontaneously; many cases with 15,000 or less have had pus present. At the same time leucocyte counts have afforded valuable evidence in certain cases. In no case where the leucocytes have reached 35,000 has pus been absent. A rising leucocyte count is of more importance than is the absolute number. Above all, leucocytosis is to be regarded as only one clinical sign amongst many. By itself it may mislead, but taken in conjunction with the pulse-rate, the temperature and the general condition of the patient, it is an additional sign which may be most valuable in the diagnosis of a difficult case.

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Group I.—*Signs local; no tumour; recovery without operation.*

No. of case.	Sex.	Age.	Days since onset.	Pulse.	Temperature.	Leucocytes.	Remarks.
1	F.	30	6	72	98·4	6,875	Uneventful recovery.
2	M.	13	3	76	99·0	7,890	Uneventful recovery.
3	M.	14	9	116	101·6	8,437	
			10	104	101·0		
			11	72	98·4	—	Uneventful recovery.
4	F.	15	8	80	99·2	8,500	Rapidly well.
5	M.	22	4	68	99·4	8,937	Uneventful recovery.
6	M.	20	9	66	98·6	4,600	
			11	56	98·8	9,500	Uneventful recovery.
7	F.	16	2	120	100·0		
			3	85	98·4	10,781	Uneventful recovery.
8	F.	17	7	112	101·0	11,000	
			8	100	100·2	—	Delayed resolution.
9	M.	21	1	112	100·2		
			2	92	99·8	11,000	Uneventful recovery.
10	M.	14	6	92	102·2	11,875	Temperature not down for 4 days.
			7	97	100·8		
11	F.	12	7	132	100·4	—	Operated on during convalescence; adhesions found; no pus.
			8	92	99·8	12,175	

No. of case.	Sex.	Age.	Days since onset.	Pulse.	Temperature.	Leucocytes.	Remarks.
12	M.	17	3	62	98·8	12,500	Uneventful recovery.
13	M.	20	2	100	100·0	12,500	Second attack.
			3	80	99·0	—	Uneventful recovery.
14	M.	13	1	100	100·0	13,000	
			2	80	98·0	—	Rapidly well.
15	F.	17	4	120	100·4	13,500	Operated on during convalescence; adhesions found; no pus.
			6	80	98·4		
16	M.	27	4	80	100·0	14,375	
			5	72	98·8	16,562	
			6	60	99·2	13,438	
			7	64	100·0	14,375	Operation discussed; not done.
			8	64	98·0	13,750	
			9	64	98·6	13,437	
			10	76	99·6	12,812	Uneventful recovery.
17	M.	39	4	92	100·4	16,800	Temperature not down for a week.
			5	98	101·0	—	Uneventful recovery.
18	M.	18	2	96	101·0	18,200	Did not resolve for 10 days; then complete recovery.
			3	102	101·4		
19	F.	17	5	118	102·2	22,500	Sixth attack; operated on during convalescence; adhesions found; no pus.
			6	120	104·0		
			9	76	98·4	6,400	
20	M.	11	12	104	103·0	23,000	
			13	68	98·0		Rapidly well.
21	M.	36	1	96	101·4	31,000	Very diffuse pain.
			2	100	100·2		Got perfectly well, but slowly.
			3	92	99·0		

GROUP II.—*Signs local; definite tumour; recovery without operation.*

No. of case	Sex.	Age.	Days since onset.	Pulse.	Temperature.	Leucocytes.	Remarks.
22	F.	18	23	104	97·6	8,300	
			24	80	99·0	—	Tumour not resolved for 2 weeks longer.
23	M.	9	10	88	98·0	8,500	Tumour resolved in 4 days.
24	F.	31	6	96	99·2	8,906	Tumour not quite gone till 16th day.
25	M.	42	19	80	98·4	9,062	Tumour not gone till 27th day.
26	M.	26	7	60	98·2	9,580	Rapid resolution.
27	F.	19	7	88	99·2	10,000	
			20	92	99·8	5,312	Small lump still palpable on discharge.

No. of case.	Sex.	Age.	Days since onset.	Pulse.	Temperature.	Leucocytes.	Remarks.
28	F.	19	15	80	97·4	11,000	Already getting better when seen.
29	F.	6	28	84	100·2	11,000	
			29	80	98·2	—	Uneventful recovery.
30	M.	18	13	72	98·4	11,384	Tumour slowly disappeared.
31	M.	29	14	92	98·6	12,800	Operated on during convalescence; adhesions found; no pus.
32	F.	23	2	84	98·8	15,000	Operated on during convalescence; adhesions found; no pus.
33	F.	48	10	112	102·6	12,500	Large tumour.
			11	104	103·6	14,750	Tumour unaltered.
			12	104	103·4	—	Tumour unaltered.
			15	96	98·6	15,600	Operation decided against.
			20	68	96·4	12,000	Tumour gone; uneventful recovery.
34	M.	30	8	64	98·0	20,625	Complete recovery.
35	M.	12	?	88	99·0	20,987	Complete recovery.
36	M.	17	5	108	100·0	21,500	Large tumour.
			6	90	100·4	18,720	Tumour less.
			11	80	97·8	19,475	Tumour less; still present.
			27	72	98·0	7,600	Complete recovery.
37	M.	23	13	60	98·2	22,000	Lump known to have been present 10 days; slow but complete recovery.
38	M.	13	10	106	102·0	19,180	
			11	96	102·0	24,375	Rapid subsidence of tumour;
			12	74	98·4	9,400	? rupture of abscess into bowel; recovery.
39	M.	40	3	80	101·4	25,625	
			4	64	99·2	—	Rapid recovery.
40	M.	11	10	94	99·0	26,000	Apparent complete resolution; did leucocytosis indicate latent pus?
			16	80	98·4	27,000	
41	F.	16	10	88	101·6	28,750	Operation much discussed; not done.
			11	86	100·4		
			12	88	101·6	—	Temperature still up several days; tumour slowly resolved; recovery.
42	M.	42	19	62	100·2	30,000	Large tumour; increased for 5 days; operation often discussed; decided against; tumour shrank from 28th day; gone on 41st day.
			22	72	101·6	18,668	
			23	74	101·0	—	
			26	48	98·4	13,750	
43	M.	9	4	100	101·0	30,625	Large tumour.
			6	96	99·0	22,395	Tumour gradually resolved in 5 days.
44	M.	12	28	96	99·0	31,600	
			30	80	98·4	18,750	Very delayed convalescence; recovery without operation.

GROUP III.—*Signs local; definite tumour; pus let out, in most cases by operation, in four by rupture into bowel.*

No. of case.	Sex.	Age.	Days since onset.	Pulse.	Temperature.	Leucocytes.	Remarks.
45	M.	12	6	104	102·2	7,500	
			7	88	98·6	—	Operation; copious pus.
46	M.	14	11	120	101·4	9,500	
			12	120	101·8	—	Operation; pus found.
47	M.	31	4	68	99·6	12,000	Operation; pus found.
48	M.	11	5	108	103·0	10,000	
			6	100	98·4	12,000	
			8	130	100·2	—	Operation; pus found.
49	M.	11	3	120	104·4	12,500	
			4	100	99·4	—	Operation; pus found.
50	M.	41	16	96	100·0	12,500	
			17	88	101·6	12,500	Operation; pus found.
51	F.	47	8	78	98·4	10,200	Large tumour.
			15	100	101·6		
			16	112	101·6	—	Tumour bigger.
			17	108	99·6		
			18	108	101·6	15,437	Operation; pus found.
52	F.	19	2	114	102·0	15,670	
			3	108	101·2	—	Operation; pus found.
53	M.	27	31	76	101·0	17,062	Operation; pus from cæcum to kidney.
54	M.	10	40	112	98·6	19,062	Operation; pus found.
55	M.	8	9	96	99·0	20,000	
			10	90	98·4	—	Operation; pus found.
56	M.	24	7	96	101·2	20,000	
			8	100	103·4	19,300	
			9	100	102·8	—	Operation; pus found.
57	M.	17	14	104	101·0	20,200	
			15	104	102·2		
			16	73	99·2	19,800	Rupture abscess into cæcum.
			17	62	98·6	5,000	Spontaneous recovery.
58	F.	21	4	124	101·4	21,000	
			5	100	100·6	—	Operation; pus found.
59	M.	45	3	108	99·0	17,000	Large tumour.
			4	100	99·0	21,000	Operation refused by patient.
			6	84	99·0	17,000	
			9	88	99·0	19,000	
			11	104	101·0	23,000	Operation refused by patient.
			12	100	100·0	21,000	Sudden rupture abscess into bowel.
			13	96	98·4	17,000	Spontaneous recovery.
60	M.	39	10	96	99·4	23,000	
			11	98	101·6	19,000	
			12	112	101·4	16,800	
			13	120	100·4	18,750	
			14	100	100·2	18,000	Operation; pus let out.
			16	72	98·4	13,470	
			17	72	98·4	16,400	
			18	68	98·0	7,500	Rapid recovery.

No. of case.	Sex.	Age.	Days since onset.	Pulse.	Temperature.	Leucocytes.	Remarks.
61	M.	11	3	130	97·6	26,000	Operation; pus found.
62	M.	52	14	104	100·0	26,250	Operation; pus let out.
			15	100	99·0	25,687	
			16	96	99·0	21,250	
			19	104	98·4	21,250	
			21	92	98·4	10,000	Uneventful recovery.
63	F.	22	12	100	101·0	14,000	Large tumour.
			21	84	100·4	30,000	Tumour persistent.
			25	108	100·4	—	Operation; pus found.
64	M.	21	7	88	101·6	21,600	
			8	100	101·8	34,062	Operation; pus let out.
			16	80	98·4	14,400	Fæcal fistula.
			21	80	98·4	14,400	
			22	80	98·4	7,000	Slow but complete recovery.
65	M.	32	10	112	101·0	38,000	
			11	134	101·0	32,500	Operation; pus let out.
			12	134	101·0	31,760	
			14	112	101·0	20,938	Rub first heard in chest.
			19	118	101·0	10,937	Extensive pleurisy.
			25	120	101·0	13,281	? Empyema.
			36	130	102·0	15,625	Empyema drained.
			49	70	98·4	8,912	Getting rapidly well.
66	M.	12	2	75	100·2	7,800	
			3	76	99·2	9,062	
			4	72	98·6	11,875	
			7	80	100·6	38,700	Operation; pus let out.
67	M.	6	6	112	97·0	39,375	
			7	96	96·6	—	Sudden disappearance of large tumour; ruptured into cæcum.
68	F.	14	10	96	100·2	18,000	Large tumour.
			14	104	99·0	42,000	Tumour larger.
			15	80	99·0	22,000	Sudden disappearance of tumour; ruptured into cæcum.
			16	80	98·4	7,000	
69	F.	14	4	124	101·6	49,000	
			5	128	99·8	21,000	Operation; pus let out.
			19	100	100·8	—	Temperature not down for over a fortnight; complete but slow recovery.
			22	96	98·8		
70	M.	24	15	100	100·8	56,750	In this case the cæcum was in the *left* iliac fossa, and the abscess contained gas and was resonant.
			21	92	99·8	—	Operation; pus let out.
			26	80	98·4	18,437	

Group IV.—*Appendicitis with General Peritonitis.*

No. of case.	Sex.	Age.	Days since onset.	Pulse.	Temperature.	Leucocytes.	Remarks.
71	M.	14	1	128	102·4	7,128	Laparotomy; general peritonitis; slow but complete recovery.
72	M.	12	4	130	102·0	10,625	Died the same night.
73	F.	17	2	136	102·0	10,800	In consultation, reported "not dangerous."
			4	100	100·0	8,125	Thought to be a little better.
			6	102	100·0	7,500	
			14	90	101·0	8,437	In consultation, still thought operation not indicated.
			17	118	101·0	10,625	Operation; suppurative peritonitis.
			22	180	105·4	—	Patient died.
74	M.	11	Same day	144	103·6	30,000	Laparotomy; general peritonitis; cured.
75	M.	16	1	122	100·6	20,000	In consultation, decided not necessary to operate.
			2	104	100·6	17,000	
			3	100	99·8	19,500	
			7	110	101·0	—	Laparotomy; suppurative peritonitis.
			9	154	101·8	31,500	Worse; pus under diaphragm.
			13	?	100·4	37,500	Death; pus all over peritoneum.
76	M.	8	9	124	100·4	39,687	No great rigidity; doubtful whether to operate; laparotomy showed acute general peritonitis, and cæcum in *left* iliac fossa.
			10	130	100·4	41,000	
			11	80	99·4	9,312	Rapid recovery.

Seven cases not belonging strictly to any of the four preceding groups.

No. of case.	Sex.	Age.	Days since onset.	Pulse.	Temperature.	Leucocytes.	Remarks.
77	F.	28	6	124	102·4	10,500	Appendicitis and suppurative pylephlebitis, not diagnosed till autopsy.
78	M	23	35	60	95·0	12,154	Gangrenous appendicitis and suppurative pylephlebitis, not diagnosed till autopsy.
79	M.	19	27	112	104·6	24,000	A very obscure diagnosis; all sorts of things suggested; at autopsy an inflamed appendix and suppurative pylephlebitis were found.
			29	112	105·0	23,000	
			44	110	102·0	20,100	
			58	114	103·0	20,625	
80	M.	22	19	140	104·0	18,000	No diagnosis till autopsy; gangrenous appendicitis, general peritonitis, and suppurative pylephlebitis then found.
			20	124	100·4	16,000	
			23	180	100·0	—	
81	M.	30	4	112	102·8	23,800	Symptoms all suggested general peritonitis secondary to an abscess; but patient recovered completely without operation. *Differential leucocyte count*:— Small lymphocytes, 8·0 per cent.; large lymphocytes, 5·0 per cent.; polymorphonucleated, 86·5 per cent.; eosinophiles, 0·5 per cent.
			5	120	102·0	17,700	
			7	100	100·6	13,300	
			9	116	101·2	13,432	
			11	100	100·0	8,755	
			12	100	100·0	11,400	
			14	90	98·4	6,500	
			15	92	98·4	8,300	
82	F.	20	13	108	100·8	25,000	Clinically seemed to belong to Group I, local without tumour; but operation 13th day evacuated much pus from behind cæcum; good recovery.
			16	84	98·4	10,000	
83	M.	23	7	92	101·2	25,000	Clinically a mild case, with no rigidity or pain; operation postponed to 10th day; died same night, general suppurative peritonitis being present. The previous pain had all been on the *left* side, and the cæcum was found transposed to this side.

Method.

In all cases a Thoma-Zeiss Hæmocytometer was used, with the special leucocyte pipette. Blood was obtained from the lobule of the ear, and was diluted 1 in 20 with Thoma's fluid. The contents of the pipette were well mixed; the first half was then expelled; the next droplet was placed in the counting chamber and counted at once.

The leucocytes in the sixteen "big" squares were counted, those cells overlapping the bottom and left hand boundary lines of each big square being omitted, but those overlapping the top and right hand boundary lines being counted in.

One count only was made from each sample; it is found that successive drops from the same mixture are apt to give ascending counts.

In many cases a second drop of blood was taken and a separate count done; in which case the average of the two counts was struck.

The counting sometimes done by different persons, but always under supervision.

My thanks are due to Dr. Frederick Taylor, to Dr. Hale White, to Dr. Newton Pitt, and to Sir Cooper Perry, who most kindly gave me permission to examine patients under their care in the wards of Guy's Hospital.

DISCUSSION.

Dr. L. S. Dudgeon considered that in cases in which an examination of the leucocytes was indicated, both an enumeration of the leucocytes and a differential count should be made. The gradual increase in the number of cells was most important in diagnosing appendicitis. Even 10,000 or 15,000 was often suggestive along with other signs. Over 30,000 was not by any means conclusive as to the presence of pus. The differential count was of great importance. In suppuration 80 per cent. or 90 per cent. of polymorphonuclear neutrophils were often found in place of the normal 65 per cent. In one case in which pus was present there was only a moderate increase of the number of leucocytes, but there was a percentage of 99 of polymorphonuclear cells. The absence of eosinophils was probably of little importance. Ehrlich's method of staining the blood with a mixture containing iodine (one part), potassium iodide (three parts), distilled water to 100 parts, and gum acacia to form a syrup, which should produce a diffuse coloration of brown or deep-brown granules in the polymorphonuclear cells, had seemed to him a very uncertain method. There was no sign absolutely diagnostic of suppuration, but a leucocyte count of 30,000 with 80 per cent. of polymorphonuclears, or of 15,000 with 90 per cent., made the probability of suppuration very great. The diagnosis of perforation in typhoid was important. A gradual increase in the number of leucocytes had been found in some of the cases. In acute intestinal obstruction he had found over 50,000 leucocytes on three occasions, while Professor Osler had recorded a leucocyte count of 80,000 per c.mm. He asked if Dr. French was quite certain that the gas in the abscess cavity was due to the *Bacillus coli communis*.

Dr. G. Newton Pitt referred to a case of appendicitis, associated with pylephlebitis, due to *Bacillus pyocyaneus;* in which there was no pyrexia and no leucocytosis.

Dr. French, in reply, had not found much value in the differential count in diagnosing suppuration. The bacillus present, according to the pathological report, was the colon bacillus. In the two cases of pylephlebitis, described in the paper, without leucocytosis, there was no blue coloration of the pus.