

THE SIGNIFICANCE OF ARNETH'S LEUCOCYTE COUNT.

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ANYONE who is in the habit of examining blood-films and making leucocyte counts must have been struck by the variety in shape and size of the nuclei of the polymorphonuclears. The nucleus may be simple in structure, often having the shape of a horseshoe, or it may be V or Z shaped. Its outer ends are generally broader than the central portion, where there is a thinning of its substance, which may thus form two lobes, nearly or entirely separate. Similarly, by sub-division, the numbers in other leucocytes may have three, four, or even five lobes, completely or nearly completely separated from each other.

That these variations may be significant Arneth appears to have been the first to recognize, in 1904. I have not had access to any of the original papers on the subject, and my information is derived from the *Practitioner* (June 1908, p. 836, and March 1914, p. 413). References to the original papers will be found there.

Arneth showed that the polymorphonuclears can be subdivided into groups according to the number of lobes in the nuclei. Five groups are so formed, according as there are 1, 2, 3, 4, or 5 lobes. In the blood of a normal person the proportions are found to be pretty constant, and the average count from a number of cases is taken as the normal.

The method has been tried by various workers, such as Groll, Paulicek, Rayevskay, Kramer, and Cooke. It has been shown that the proportions of the groups may be altered in different morbid conditions. Special attention has been directed to tuberculosis and typhoid, and it is found that there is a distinct shift to the left in these and other diseases. Group 2 is increased at the expense of group 3, which in turn may be increased at the expense of group 4; group 1 is also increased. This shift to the left has been most fully determined in phthisis, and is more marked the more advanced the disease.

For some time past I have been working at the method, and have obtained results that are generally confirmatory of those observations. The method is rather tedious but not difficult. First of all, it is necessary to find a normal, by making counts of the blood of healthy persons. In all my cases, normal and otherwise, the films were taken between 11 A.M. and noon, so as to ensure standard conditions. This was about two hours after the morning meal. Possible fallacies due to variations in the differential leucocyte count owing to ingestion, etc., were thus avoided.

It is necessary to count at least 500 polymorphonuclears in each case. After getting over initial difficulties, I succeeded in obtaining a satisfactorily constant normal count, the greatest departures from the mean not being very large. The work involved took so much time, and was so trying to the eyesight, that I trained a young and able Burman, who is skilful with the microscope, to employ the necessary technique, and I found that his methods, under checking, were satisfactory.

My own normal was somewhat different from Arneth's, and more resembled Kramer's, but that of my assistant proved to be a close approximation to that of Arneth or Rayevskay. In work of this sort, it is necessary that one worker alone should make the counts, in order to minimise personal error, as in the estimation of the opsonic index. Further, it was found that by employing a mere enumerator, bias in favour of a certain result was eliminated, since he did not know in what direction the result might be expected to tend. Re-counts of any case were made in ignorance of the result of the earlier enumerations.

Arneth's normal reads thus:—

I	II	III	IV	V
5	35	41	17	2

That adopted by me:—

4.5	34.5	40	18	3
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and was based on the study of over 24 cases.

On these lines, counts were made of the blood in about 130 cases of different morbid conditions.

As the result, it was found that there was a decided shift to the left in such diseases as tuberculosis, malaria, and measles. This shift to the left was not constant, and varied in amount. Thus, in 10 cases of tubercle, mostly of the lungs, there was a marked left-shift in four cases, a definite shift in 5 cases, and no shift in one case. In my cases, the amount of shift is not so pronounced as in the work of Paulicek or Kramer, and they are perhaps too few on which to build generalizations, but, as far as can be judged, the phenomenon is a real one. It is claimed that the amount of shift is of prognostic significance, and it is hoped to investigate this with further material. There is, however, among my cases evidence that as the disease advances the left-shift increases in amount.

In *measles*, in most cases there is a decided shift to the left. Of 20 cases studied, the shift was marked in 7, definite in 6, slight in 2, and not found in 5. No relation between the amount of shift and severity of the infection could be established, as all the cases were nearly equally mild.

It was in some cases of this disease that the greatest amount of shift was seen. It was a

very distinct phenomenon. Thus, 2 cases gave the following readings:—

Group	I	II	III	IV	V
(a)	15'3	53'5	28'0	3'2	0
(b)	13'5	54'3	29'0	3'2	0

In these instances it was easy to see that the polymorphonuclears were abnormal. In the first place, there was a leucopenia, it being necessary to make 6 films in order to count 500 polynuclears. The polynuclears were not relatively increased, and it was readily observed that a considerable proportion of them had large swollen nuclei, showing little tendency to subdivide into lobes, and in comparatively few was there that complete fission of the lobes which is common in normal bloods.

In *malaria* the shift is pretty constant. Out of 21 cases, it was marked in 4, definite in 13, and absent in only 4. It was, on an average, equal in the tertian and subtertian fevers, and a single case of quartan gave a similar finding.

A similar shift was seen in some cases of fever to which no cause could be assigned. Most of these resembled malaria, but no parasite could be found. In other cases of fever of undetermined cause the left-shift was absent or very slight. On the whole it may be fairly said that absence of the left-shift is presumptive evidence against malaria.

In inflammatory conditions of a local nature, not associated with a general infective process, there is as a rule no shift to the left. Thus, it was absent in a case of boil, of acute abscess, of poisoned wound, and of septic bubo. It was present however in one case of acute lymphangitis, and in one of indolent ulcer.

It was well marked in two cases of *filaria fever*, and found in a case of acute diarrhoea, in 2 cases of acute lobar pneumonia, in acute pleurisy, acute bronchitis, quinsy, and acute rheumatism (one case of each).

A marked shift to the left was found in an obscure case the day before he died. Death was due to septic absorption from a gangrenous inflammation of the caput cæcum coli and ascending colon. A left-shift was not found in two cases of the peculiar general infective disease that is not uncommon in Rangoon, especially in morphine injectors, and described by Captain Whitmore, I.M.S.*

Evidence was obtained of a *shift to the right* in certain morbid conditions, e.g., in syphilis, amœbic dysentery, and ankylostomiasis. But the results were on the whole equivocal, and further observations are being made. In one case of acute hepatitis that yielded to emetine there was a shift to the right, and the same phenomenon was well

marked in a case of sprue in a Scotchman. On the other hands, in three cases of acute diarrhoea with fever there was a pronounced left-shift.

In *leprosy* there is evidence of a definite shift to the right. This was seen in 12 out of 16 cases examined. In 3 there was a left-shift. It was in cases of this disease that the most marked shift to the right was found. Thus, in two instances the reading was:—

	I	II	III	IV	V
(a)	1'5	24'5	48'1	23'0	2'9
(b)	1'6	25'5	49'3	21'0	2'6

A case of this sort gives a picture that contrasts in a marked manner with that of the measles cases mentioned above. There are few polynuclears with one of two lobes; nearly all show subdivision very distinctly and this subdivision is complete in a large proportion of leucocytes.

A right-shift was noted in a single case of scurvy, and in a case of what was diagnosed pernicious anæmic.

It is not yet possible to make dogmatic generalizations as to the value of this method in regard to prognosis and diagnosis. More extended observations must be made. There is some evidence that the count may be of value in diagnosis in certain cases, e.g., of suspected tubercle. Thus, observations were made in a case of pleurisy, possibly due to tubercle, a case of subacute pneumonic consolidation, a case with obscure physical signs in the lungs,* and a case of low irregular fever, without discoverable physical signs. In none of those was there a shift to the left, and so far this may perhaps be regarded as presumptive evidence against tuberculosis. Similarly in a doubtful case of fever, absence of shift is, I believe, an indication against the diagnosis of malaria.

The increase or decrease in the first and second groups as a rule bears no relation to the differential count. It might be supposed that an increase in these groups is merely an expression of a high percentage of polymorphonuclears, and *vice versa*. But this is not the case. There is no increase of these leucocytes in malaria, but generally a decrease, and yet the left-shift is fairly constant. A definite left-shift may accompany a relative polynuclear increase or a decrease, or the ratio may be normal. In measles there is no increase of the polymorphonuclears.

Nor is the temperature of the patient related to the result of the count; a low temperature may go with a definite left-shift, and *vice versa*.

In the case of tuberculosis, however, there is, I think, some evidence that the polymorpho-

* Morphine Injector's Septicæmia, Whitmore, I. M. G. p. 263 (1912).

* This case was thought to be in all probability one of Tuberculosis. Since writing this paper it was proved to be a case of "Whitmore's disease."

nuclears are relatively increased the more advanced the disease. The point will be investigated.

The following table shows counts obtained in different diseases. They are chosen to illustrate the points discussed.

Case.	I.	II.	III.	IV.	V.	Polymorphonuclears per cent.
Normal	4.5	34.5	40.0	18.0	3.0	—
Phthisis	12.3	48.3	33.8	5.4	0.2	70
Phthisis	13.2	48.8	35.8	4.0	0.2	67
Subtertian	8.4	51.4	35.0	5.2	0.0	41
Double Tertian	11.5	53.4	29.7	3.4	0.0	49
Measles	6.8	50.6	39.4	3.1	0.1	65
"3-day fever" (?)	14.6	47.2	34.9	3.3	0.0	55
Filarial fever	7.6	53.6	33.8	4.8	0.2	58
Acute Conjunctivitis	3.0	37.0	48.6	11.0	0.4	48
Septic Bubo	2.5	38.9	44.9	12.9	1.3	76
Leprosy	3.0	27.6	51.6	15.9	1.9	65
Sprue	0.5	22.0	38.5	28.2	10.8	59

I hope to continue the study of this method, in order to find out the extent of its value in the diagnosis and prognosis of infective and other conditions.

CONCLUSIONS.

- (1). Arneith's method is of distinct value in clinical pathology.
- (2). The ratio of the different groups is fairly constant in normal bloods.
- (3). There is a shift to the left, of greater or less extent, in several infectious diseases. It is well seen in measles, and is pretty constant in malaria.
- (4). There is evidence of a right-shift in some infections, notably in leprosy.
- (5). In tuberculosis the shift is more pronounced the more advanced the disease.
- (6). Absence of shift is presumptive evidence against a diagnosis of tubercle or malaria.

valvular disease. Thirteen have been sent on sick leave with a view to invaliding. These figures, however, do not represent adequately the incidence of damaged hearts, as others, which might well come under this heading, have been returned as debility. These cases are not transient affections, such as might be caused by flatulent dyspepsia, and they are not cases of physiological enlargement and increase of pulse rate; they are cases in which the patient has, either permanently or for some months, suffered bodily infirmity on account of the condition of his heart.

Analysis of the cases indicates that there are two outstanding causes—malaria and overstrain, and that a combination of these two is responsible for a large proportion. Given this, there is every reason to suppose that, by the exercise of care, many subjects might be protected from heart injury.

A short outline of a few cases will be sufficient to indicate the type of injury, and the circumstances under which it occurs:

1. A case of mitral incompetence in a young man of good physique, arising from no known cause and progressing steadily in spite of prolonged rest. The patient was invalided in a condition precluding him from any wage earning occupation.
2. A young Punjabi, belonging to a Mountain Battery, complained of shortness of breath. He was found to have a large heart and definite mitral regurgitation, probably due to relative incompetence. There was no predisposing disease. The patient was invalided as he showed no signs of recovering.
3. A case very similar to the above, complaining of persistent throbbing of the chest. The pulse rate was constantly above 100, occasionally a slight systolic bruit could be heard at the apex.
4. Afridi, æt. 25, shortly after manœuvres, complained of pain over the region of the heart. The heart was large, rapid in action, occasionally irregular, the front of the chest was heavy, and the patient incapable of any exertion. After six months there is some degree of recovery, so that the patient is capable of light work, but any effort is liable to cause pain over the heart.
5. Sikh, æt. 23, 3 years' service, complained of dyspeptic pains shortly after manœuvres. He was found to have a rapid dilated heart with mitral reflux.
6. Sikh, æt. 22, complained of increasing shortness of breath, dilated heart, rapid pulse, evanescent adventitious sounds. Invalided after four months' treatment.
7. Afridi, æt. 34, 14 years' service, complains of breathlessness on exertion. Has been doing

A Mirror of Hospital Practice.

HEART STRAIN AMONG SEPOYS.

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THE returns of a hospital accommodating the sick of some 3,800 men, all of good physique, shew that, during the last two and a half years, there have been no less than 37 admissions for diseases of the heart. Twenty-five of these were diagnosed as disordered action and twelve as