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Sedimentation rate

Leroy C. Askwig
University of Nebraska Medical Center

SEDIMENTATION RATE

BY

LEROY CHARLES ASKWIG

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INTRODUCTION

Aside from the fact that this paper is being written because it is required it seems that this is the proper place to give my reasons for choosing this particular subject. This subject was first brought realistically to me by an examination question, worded: "Discuss Sedimentation Rate". That is exactly what I will attempt to do in the pages to follow. Another factor in my choosing this subject is that even after a miserable failure in the examination it was impossible to forget sedimentation rate. This patient would be displayed with a sedimentation rate of so much, another with the same disease would have a different rate and so on. What was the meaning of sedimentation rate, and how could anything so variable be of any aid to clinical medicine were questions that I could not answer.

Needless to say the value derived from the writing of this article goes only to the writer and because no original work has been done possibly my conclusions from the work of others may be amiss. It is certain that my conclusions cannot be accepted as authentic or the last word and so they are of no value and do not contribute to the knowledge of the

profession.

Cutler (19) has grouped the following diseases according to their sedimentation rates:

With Abnormal Sedimentation Rate

1. Chronic infectious diseases, such as tuberculosis and syphilis.
2. Acute infectious diseases, such as pneumonia, septicemia, acute endocarditis, the exanthemata and acute bronchitis.
3. Malignancy.
4. Localized suppurations, such as pelvic inflammatory disease, suppurative mastoiditis, suppurative sinusitis, empyema of the gall bladder and bronchiectasis.
5. Acute intoxications, such as lead and arsenic poisoning.
6. Certain endocrine disturbances, such as thyrotoxicosis.

Influencing the Sedimentation Rate Very Little if at All.

1. Simple catarrhal inflammations, such as acute catarrhal appendicitis, simple rhinitis and colitis.
2. Chronic ulcerations of small extent, such as gastric or duodenal ulcer.

Not Influencing the Sedimentation Rate

1. Functional diseases, such as the various neuroses, and neurasthenia.

2. Certain nervous diseases, such as dementia precox.

3. Focal infections, such as abscessed teeth, diseased tonsils and chronic sinusitis.

4. Allergic diseases, such as asthma and hay fever.

5. Metabolic diseases, such as uncomplicated diabetes and essential hypertension.

6. Most skin diseases.

7. Simple growths, such as fibroma, lipoma and fibromyoma.

8. Simple cysts.

9. Chronic valvular disease of the heart.

This paper will deal with some of the above conditions in which the sedimentation rate is said to have value clinically. The various techniques and their hundreds of modifications will be discussed only sufficiently to give the reader some idea of the more commonly used and their normal values so that the paper may be more clearly understood.

HISTORY

Fahraeus (25) gives the history that led up to the development of the sedimentation rate as we understand it today. According to the pathology of antiquity, as expounded by Hippocrates and Galen, health was conceived as dependent upon the normal mixture of four fluids which were believed to compose the vascular contents, thus forming what we call blood. As is well known these four fluids were : the yellow bile, cholera, the serum which separates from the blood-clot; the black bile, melancholia, a dark colored substance in the lowermost portion of the blood-clot; sanguis, the upper bright red of the blood-clot in contact with the air; and the mucus or phlegma, answering to what we now call fibrin.

They believed the phlegma to be most important in disease because blood drawn from diseased persons was found covered with a fibrinous layer. Moreover it was known at that time that the clotting of blood depends on the coagulation of the phlegma. This view was substantially supported by the fact that well-marked so-called fibrin coagula, arising post mortem in the heart and in large vessels in a perfectly analogous manner to the above mentioned fibrinous layer

in drawn blood, are found at autopsy of persons who have died from disease, being absent on the other hand in cases of violent death.

Waugh (99) explains the development of this fibrinous layer in a clearer manner by saying that in some affections, particularly the acute inflammatory processes, there occurs a marked acceleration of sedimentation of the blood cells ## in the drawn blood. Sometimes this occurs so rapidly that there is a partial sinking of the cells away from the surface, before coagulation sets in, leaving a clear, yellowish serum.

Again according to Fahraeus (25) the downfall of the antique four-fluid theory in modern times did not, as a matter of fact, diminish the importance of the fibrinous layer. In the literature of the 17th, 18th and 19th centuries, this formation is known under many names such as crusta inflammatoria, pholgistica, pleuritica--couenne du sang--buffy coat--Faserstoffhaut, Speckhaut. Thus altered, the blood was called buffy or sizy, the Germans named it "zerfallenes Blut."

The Greeks were right when they believed that the clotting of blood depended on coagulation of the phlegma; the old physcians of later times were wrong when they thought that clotting was due to the clustering of the red cells. The existence of these formations having been demonstrated by aid of the micro-

scope, the blood was considered to consist of only two main constituents, namely, the red cells and what we now call serum. The consequence of this oversight was that the fibrin collecting at the top of blood drawn from diseased individuals was interpreted as a substance entirely alien to the composition of normal blood, the presence of which was thought to explain the most varied clinical symptoms, as fever, perspiration, eruption on the skin and so forth. The buffy coat was as a matter of fact the salient point in the general pathology of the clinical leaders of the time. Sydenham, for instance, believed the common cause of all febrile diseases to be an inflammation of the blood, the pathognomonic sign of which was the <u>size</u>. Boerhaave thought that all disturbances of the circulation in disease were due to this same substance lodging in the narrow vessels.

To give only an idea of the significant bearing of these observations on the treatment of disease, it may be mentioned that the theoretical arguement in favor of venesection--the supreme method of treatment for thousands of years of medicine--was founded on the conception that by emptying the vessels of their contents the organism could be relieved more or less from

the materia morbificans, i.e., the substance of the buffy coat.

As will be seen by the following the sedimentation velocity of the red corpuscles is increased during one physiological condition, namely pregnancy. Pregnant women had buffy blood and were therefore victims to blood-letting in a formidable degree, a proceedure still in use at the beginning of the last century.

As the conception of the humoral causes of disease was supplanted by the cellular pathology of Virchow, the changes in the blood were relegated to the background, and after a few decades the existence of the crusta inflammatoria was completely forgotten--a fact to which the discontinuance of venesection naturally contributed.

Cutler (16) has found that John Ashhurst in 1893 taught that the blood in inflammatory conditions showed the following change: "Owing to changes in the constitution of the blood in inflammation, its mode of coagulation differs from that of blood in normal state. The crassamentum or clot forms more slowly than in health, and is smaller and firmer in consistence. The slowness of coagulation and the increased cohesiveness of red corpuscles allow the separation of the fibrin

and white corpuscles to take place before the process of clotting is completed, and this gives rise to the peculiar appearance which is known as the buffy coat."

Biernacki, in 1897, reported a series of seventy-five sedimentation tests. He concluded that the test might be of some value in the diagnosis of diseases, according to Hunt (49).

Fahraeus (25) of Stockholm, working in the Physiological Institute of the University of Kiel, whose accidental observations (1917) on the increased sedimentation velocity of the red cells during pregnancy, have renewed interest in these hematologic questions and during the last decade thousands of papers concerning the sinking speed of the erythrocytes have been published.

TECHNIQUE

Ellenberger (22) notes that a review of the literature quickly impresses one with the fact that a great number of methods have been evolved to obtain the sedimentation speed of erythrocytes. It is because of this variety of methods and the different terms employed in expressing the results that the reader is hard put to compare the sedimentation values as obtained by different authors and is forced to content himself with the conclusions of the author that the sedimentation reaction is normal, increased or decreased in certain conditions, pathologic or otherwise. This lack of standardization may perhaps account for the conflicting statements, as to the sedimentation reaction in normal individuals and in various diseases appearing in the literature and undoubtedly impairs the value of the test.

It is not purpose of this paper to go into the various methods of determining the sedimentation rate or the relative values of each. Mora and Gault (65) summarize by saying the most commonly used methods of determination are those of Fahraeus and Westergren (the "Distance method"), in which the sedimentation speed is obtained by measuring the distance passed by

the uppermost layer of red cells from the upper meniscus of the fluid column in a given time, and that of Linzenmeier (the "Time method"), in which the time in minutes is taken that is required for the corpuscles to sink a certain distance marked on a specially calibrated tube. Friedman, S. (31) adds the method developed by Cutler which combines the principal features of both the time and distance methods, and, by using both variables, expresses the actual velocity or rate of sedimentation of the red cells. The method consists of recording the distance through which the red cells sediment# at frequent intervals of time, that is, every five minutes, for one hour, and then charting the results in the form of a graph, using sedimentation in millimeters as ordinates, and time in minutes as abscissae.

Greisheimer, Treloar and Ryan (40) give the requirements for each of the above techniques. The short stout tube (11.2 mm. internal diameter) used in the Cutler method requires 0.5 cc. of 3% sodium citrate and 4.5 cc. of blood. The Linzenmeier method, using a short narrow tube (5 mm. internal diameter), requires 0.2 cc. of 5% sodium citrate and 0.8 cc. of blood. The liquid columns as formed in these two types of tubes are of the order of 55 mm. and 44 mm. respectively.

The Westergren method calls for a long narrow pipette, into which is drawn to a height of 200 mm. a mixture of 0.25 cc. of 3.7% sodium citrate to every 1 cc. of blood. Thus the three methods differ widely in diameter and length of the fluid column, and in concentration of the anticoagulant. Also the Linzenmeier method calls for measurement of the time required for a sedimentation of 18 mm. while the Cutler and Westergren techniques employ as indices the length of clear plasma at the end of one hour of sedimentation. While these differences appear to be simple, considered individually, they provide collectively a complex that is difficult of resolution in terms of differences in the indices. #

Perhaps another method, Landau (56), which needs consideration is the Linzenmeier-Raunert microsedimentation. This method has an advantage in that only a few drops of blood are needed which may be obtained from the finger or the ear. It is particularly valueable in children and in obese people where difficulty in obtaining venous blood is encountered.

In more recent literature it has been shown that anemia is a factor in increasing the sedimentation rate. Walton (98) has developed a method of correcting the rate to a red cell count of 5,000,000. He

calls this the corrected sedimentation rate (C.S.R.) and finds it gives much more accurate results.

Normal values for adults by the Westergren method are generally given as eight to twelve mm. in one hour. For the Linzenmeier 180 to 300 minutes to reach the 18 mm. mark. On the Cutler graph normal rates approach a vertical line while rapid rates approach a horizontal line. One to eight mm. is normal for the Linzenmeier-Raunert method.

Greisheimer (39) gives the following generalities as to the speed of sedimentation; 1. The sedimentation rate shows some variation from week to week among normal men. 2. The sedimentation rate shows slightly more variation from week to week (exclusive of menstrual periods) among normal women than among men. 3. The averages show that the rate of sedimentation is faster in women than in men. 4. The sedimentation rate during the menstrual periods is not faster than between periods. In all of 18 cases as rapid a rate was found between periods as during the periods. This is in disagreement with most other authorties who find the rate more rapid during mensturation. Waugh (99) finds the sedimentation rate in the new-born up to the fifth week to be the same that it is in adult life but throughout youth (up to the 14th year) there is a

marked increase in the sedimentation rate. This he attributes to a lack of stability and the influence of many minor infectious diseases which alter the results.

Alexander (1) emphasizes that whatever the technique the equipment must be clean and dry. The sedimentation tubes should stand upright because tipping changes the results. Sedimentation proceeds the fastest at body temperature. At room temperature (20° C.), the rate of sedimentation is approximately 80% of that at 37° C. At 45° C. no sedimentation at all takes place, while at 0° C. it is exceedingly slight. It is therefore seen that for all clinical purposes, room temperature answers the purpose best.

NATURE OF THE PHENOMENON

Many theories have been advanced to explain the nature of the sedimentation phenomenon. Waugh (99) explains that at the time of his article there were two schools as to the cause. The older, headed by Gruber, sees the cause in the adhesiveness of the cell surfaces; the other, more recent and now more generally accepted, explains agglutination by an adsorption phenomenon resulting from the lowered electrical burden of the suspended particles. Hoeber showed, in 1904, that erythrocytes wander to the anode and, therefore carry a negative electric charge, and was of the opinion that this # burden was carried by the plasma surface. Schurer and Eimer, moreover, showed that the corpuscles of healthy men wander to the anode much more quickly than those of pregnant women and concluded, therefore, that in pregnancy and certain disease conditions the electrical burden of the cells is diminished and consequently, agglutination more rapidly occurs and sedimentation velocity is increased.

Attention was more or less diverted for a time from this original physical conception by researches which showed that rapid sedimentation was associated with changes in the relative proteid composition of the

plasma, as, for instance, an increase in the globulin fraction and a decrease in the albumin. The followers of Hoeber's ideas, however, showed that these different proteids exert different influences on the electrical burden of the corpuscles, and that the negative burden is greater in albumin than globulin solutions. Consequently, if globulin replaces albumin in the adsorption envelope of the corpuscles, the isoelectric point is approached and more rapid sedimentation occurs.

Cherry (12) and Hunt (50) support the work of Fahraeus and numerous others who have concluded that the increased rate of sedimentation of erythrocytes is due to their increased agglutination, and that this agglutination is chiefly dependent on the properties of the plasma. They have found by crossing cells of blood in which sedimentation takes place slowly with plasma of rapid sedimentation blood the rate was still rapid. If the cells of rapid sedimentating blood were put in plasma of slow blood the sedimentation rate was slow.

Hunt (50) from the work of Gram and Chandler reports an increase in fibrin values particularly in the later months of pregnancy. Pfeiffer reported an extensive series of cases in which the content of fibrin of the blood in disease had been estimated.

In general he found an increase of the fibrin of the blood in the presence of diseases which are accompanied by leucocytosis; but in leucemia the fibrin content was normal. In diseases without leucocytosis the content of fibrin was normal. This is supported by the work of Erben, Gram and Foster.

Cherry (12) maintains that there are apparently two factors that influence the change of rate, cell volume and the variations of fibrin, eugloblin, and globulin in the plasma.

Haskins, Trotman, Osgood and Mathieu (44) summarize the various theories and give the supporters of each.

1. Increase in fibrinogen causes an increase in the sedimentation rate according to Katz, Blaut, Starlinger and Frosch, Plass and Rourke, Abderhalden, Levinson, Gram and Chandler, Pfeiffer, and Erben, Linzenmeier, Buscher, Westergren and Alexander.
2. Schmitz, Sachs, Salomon and Fischel say it is an alteration in the albumin-globulin ratio.
3. Wichels believes it is due to a destruction of red cells.
4. Kurten says there is an increase in the blood cholesterol.
5. Leendertz bases it on the development of antibodies.

6. Lohe and Herzfeld and Schiniz say that there is an alteration in viscosity.

7. Jevons, Hoeber, Risse, Waugh and Poole believe that it is due to electrical changes in the plasma.

8. Gruber, Dewitt, Long and Haskins, Trotman, Osgood and Mathieu believe it due to a change of surface tension.

In any investigation on sedimentation, Newham (70), one must naturally take into consideration the well-established law of physicists known as Stokes's law, according to which the speed of sedimentation, V, is directly proportional to F, the force of gravity, and inversely proportional to n, the viscosity of the dispersion medium, as well as to r, the radius of the particle in accordance with the formula $V=F/6"nr$.

It will readily be appreciated that one or more of these factors may be much altered in different disease conditions. It will be seen, therefore, that the problem of determining the factor or factors underlying the speed of sedimentation of blood is an extremely complex one and probably dependent on a mixture of physical and chemical factors.

Newham (70) and Newham and Martin (71) conducted several investigations attempting to prove or disprove the various theories as to the cause of the rapid sed-

imentation of red cells in certain diseases.

Their conclusions were that Hypercholesterolaemia, Fibrinogen, Albumin-globulin ratio, Blood groups, Specific gravity and viscosity of the red cells and plasma, and Size of the red cells, had nothing to do with the increase in sedimentation rate because nearly all of their cases with rapid sedimentation rates were within normal limits in the tests they ran for each of the above.

They did find that anemia increased the sedimentation rate in accordance with Stokes's law. In contradistinction to Hunt (50) and many others, Newham(70) found that by crossing cells of blood in which sedimentation takes place slowly with plasma of rapid sedimentating blood the rate was slow but if cells of rapid sedimentating blood were put in plasma of slow the sedimentation rate was rapid. He concludes therefore that the cells are the main factor in rapid rate.

Newham and Martin (71) by tests on agglutination by the Dyke's technique found all the most rapidly sedimenting bloods showed auto-agglutination, and to them this condition has appeared to be undoubtedly the most important factor in causing rapid sedimentation.

Cutler (16) and nearly all other authors agree,

that regardless of theory, the ultimate cause apparently depends upon the degree of cellular destruction going on in the body. The sedimentation reaction is generally regarded as a measure of pathologic activity and therefore as a symptom of an entirely general kind. It is a fine quantitative measure of the change in the blood, produced by a destructive process somewhere in the body. It does not diagnose nor does it localize the infection. It does not indicate the state of the diseased organ, but it does reflect the disturbance produced in the organism through the adsorption of products of infection.

TUBERCULOSIS

Cutler (16) has defined the sedimentation phenomenon as a nonspecific reaction of citrated blood, manifesting itself by striking differences in the rapidity with which red blood cells sediment, being much slower in health than in disease. The test consists in observing the rapidity with which the red blood cells settle out from the plasma. In healthy individuals the rapidity of sedimentation varies within certain limits, just as the leukocyte count and pulse rate.

With this in mind let's see what diseases affect the sedimentation rate, how, and to what uses the sedimentation rate can be put clinically.

Let us first consider the sedimentation rate in tuberculosis.

Cutler and Cohen (17) have the following view on its use in tuberculosis.

After all, there is more to the diagnosis of tuberculosis than the finding of tubercle bacilli in the sputum or rales in the chest. The X-ray and physical examination reveal the pathological changes which have taken place in the lungs. But what the physician is most desirous of knowing is more important. How much constitutional disturbance is this tuberculosis

producing? Is it active? Does it require special treatment? These questions are often difficult to answer, requiring great skill and much experience. Determining activity in tuberculosis is the hardest task that confronts the chest specialist.

Since the future welfare of the patient in great measure depends upon the proper evaluation of the activity of the tuberculous process, the sedimentation test should become indispensable in substituting fact for opinion.

No claim is made for this test as a procedure for diagnosing pulmonary tuberculosis. It cannot do this, for the test is nonspecific. The sedimentation test merely reflects the disturbance produced in the blood through the absorption of products of tissue destruction and serves as a measure of such destruction regardless of etiology. With this clearly in mind, the sedimentation test, nevertheless, serves as a valuable diagnostic aid, for it completes the diagnosis in the same sense as does fever or pulse-rate. Like these, it measures the intensity of the tuberculous process, only it is far more accurate.

For instance, in the group under consideration are included 146 patients, in all of whom a definite diagnosis of pulmonary tuberculosis was established.

In 86 the tuberculosis was active and in 60 quiescent, as determined clinically by the physician and as based upon available information with the exception of the sedimentation test. The sedimentation test was found active in 87% of the clinically active group, and inactive in 97% of the clinically inactive group.

A follow-up group of 195 patients, each one of whom was definitely tuberculous and came to the clinic regularly for follow-up after discharge from a sanatorium. This group was divided clinically into two groups, consisting of 80 with active tuberculosis and 115 with inactive tuberculosis. After all the data were tabulated and analyzed an attempt was made to assign a definite value to each sign or symptom of importance to the physician in helping him estimate activity.

Active pulmonary tuberculosis:

Active sedimentation reaction	84%
Condition poor	80
Positive sputum	76
Fever	75
Rales	71
Pleurisy	69
Night sweats	65
Rapid pulse	61
Blood spitting	60
Cough	52
Fatigue	49
Expectoration	41
Below normal weight	36

Quiescent pulmonary tuberculosis:	
Quiescent sedimentation reaction	85%
No rales	82
No cough	78
Condition good	68
No fatigue	67
Negative sputum	66
No expectoration	63
No night sweats	60
No blood spitting	59
Normal weight	53

Cutler and Cohen (17) conclude: 1. The sedimentation test is the most valuable single means for estimating activity in pulmonary tuberculosis and can safely be said to have an accuracy of at least 94% by splitting the 12% difference between the test and clinical judgment and a 6% inaccuracy assigned to each. 2. It is of inestimable value in completing the diagnosis of pulmonary tuberculosis in that it measures the constitutional disturbance that the tuberculous process is producing, just as the X-ray or physical examination reveals the pathological changes that have taken place; and it should be included as part of routine practice when diagnosing pulmonary tuberculosis.

Kaminsky and Davidson (53) agree with Leon Bernard, who recently said that, admitting we cannot base a prognosis on one reaction, yet, of all the reactions that have been advanced, the sedimentation test is probably the one which offers the best guarantee and security in prognosis. They conclude from their sed-

imentation tests on a series of 500 cases: 1. There is a close parallelism between activity of the lesion and the sedimentation rate in pulmonary tuberculosis. The group of patients whose sedimentation rates where the slowest showed the lowest incidence of positive sputa, cavity-formation, pulse and temperature elevations and substandard weight. The group of patients whose sedimentation rates were rapid showed the highest incidence of objective signs of activity. 2. There were no cases with active pulmonary tuberculosis showing normal sedimentation values on repeated tests. 3. In four patients who died at the institution, the sedimentation tests done within a month before death showed slower sinking velocities than the tests taken in the preceding months. 4. The sedimentation test is of considerable value as an indicator of activity. A single determination may be of some help in appraising a case of pulmonary tuberculosis, and repeated tests may furnish much additional information as to the progress of the case and serve to estimate effectiveness of treatment.

Hakansson (42) considers that no case of suspected pulmonary tuberculosis can be free of suspicion so long as there is an abnormal sedimentation rate. He also believes that cases of acute or chronic bronchitis

a sedimentation rate which returns to normal shortly after the temperature becomes normal constitutes strong evidence against the infection being tuberculous. He says a case of tuberculosis should not be considered in complete quiescence if the sedimentation rate has not returned to normal, even if no other symptom or sign of activity can be elicited.

Cutler (18) also emphasizes the value of the sedimentation reaction in artificial pneumothorax.

He explains that the usual criteria are of little help in estimating the activity of a tuberculous lesion in a lung treated by artificial pneumothorax. When the diseased lung is put at rest constitutional symptoms usually disappear, and the physical signs and X-ray appearances reflect, not the pathological process, but the induced collapse.

How to advise such a patient, when and how far to limit exercise, when to permit a return to active life, are some of the most difficult problems that confront the chest specialist because of the uncertainty he feels in extimating activity. In the past three and a half years Cutler has studied the sedimentation test in a group of 131 patients for varying periods of time after instituting artificial-pneumothorax treatment, and has learned to use it as an index of progress or

retrogression of the lesion. Clinical experience has shown that a patient with a rapid sedimentation rate, even in the absence of other indications, should be treated like a patient with signs and symptoms; when it becomes normal he should still be kept under careful observation for some time to ensure stability.

During the early part of the treatment the sedimentation test should be repeated at least once a month and afterward every two months. The patient should be warned that the disease is active and that a relapse is possible. Exercise should be prescribed with great caution and its effect studied carefully by means of the sedimentation test regardless of how well the patient may feel clinically. Adherence to this rule will prevent many a relapse and spread in the opposite lung.

Cutler (16) finds the blood sedimentation test is more trustworthy than any one of the following symptoms and that there is no definite # relation between them: 1. Extent of pulmonary involvement; 2. Curved nails and clubbed fingers; 3. Duration of disease; 4. Duration of clinical activity; 5. Presence or absence of tubercule bacilli in the sputum; 6. Cough and expectoration; 7. Statement of the patient as to his general condition. As an aid in estimating activity, the sedimentation test is more reliable than temperature

curve, pulse rate or gain in weight, the three major guides in the treatment of tuberculosis.

Pinner, Knowlton and Kelly (73) find that although a higher average rate is found in active tuberculosis than under normal conditions, this increase is far from constant and it is not parallel with the extent and the progressiveness of the lesions. The prognostic value of the sedimentation test is minimal, and with the exception of extremely rare instances, this test is not apt to furnish information beyond that gained by clinical and bacteriologic observations.

Spector and Muether (89) find the blood sedimentation test is superior to the thermometer or total leucocyte count for studying clinical as well as pathological activity but find the modified Arneth method is just as sensitive in detecting early infection as any sedimentation test yet introduced. It is not as time consuming to do. They find the Schilling count inferior to the sedimentation test and to the Arneth test. However, it throws more light on the question of resistance of the patient. They conclude therefore that a combination of the modified Arneth and the Schilling tests would give more information as to activity of the disease, prognosis, and resistance of the individual than any sedimentation test yet introduced.

The above two references were the only ones that did not share the enthusiastic view point of Cutler and they do not say that the sedimentation test has no value in tuberculosis.

In conclusion it seems from the literature covered that the sedimentation test is of definite value in treatment of tuberculosis, indicating the patients condition far more accurately than all other methods of prognostication.

OBSTETRICS AND GYNECOLOGY

Perhaps Fahraeus's original idea, that the sedimentation test might prove of value in the early diagnosis of pregnancy, has stimulated interest causing much to be written about the use of the test in obstetrics and gynecology.

Smiley (87) finds the test has no value as an aid in the early diagnosis of pregnancy. It is not until the twentieth week of gestation that the rate begins to increase and continues until term. By the twentieth week other signs of pregnancy are present and the increase in sedimentation is not enough to make certain that it is not a physiological variation. For the first two or three days following labor the rate remains quite rapid, then slowly returns to normal. The failure of the rate to return toward normal may be a premonitory sign of an impending puerperal infection in the course of development. A continued decrease in time or the rate would indicate an infection of a severe grade with a prognosis more than likely doubtful. Conversely, a gradual slowing up of the rate means a rapid return to normal. The test, then, may be found to be extremely useful in estimating the prognosis of puerperal infections basing the knowledge of existing conditions relating to infection on the rise or fall

of the sedimentation time. The knowledge gained or to be gained by means of the test is more accurate, and can be recognized much earlier than any gained by observation of the temperature curve and study of the leucocytes.

Waugh (99) summarizes the literature by saying that the use of the sedimentation test as a diagnostic sign of pregnancy has been universally dropped because of the marked acceleration during menstruation and especially in inflammatory conditions.

Waugh (99) points out that Linzenmeier found the test particularly valuable in the differential diagnosis between ectopic gestation and disease of the adnexa. Using the 18 mm. line as an end point in a series of 32 extrauterine gestations, he found that in twenty sedimentation occurred between forty and ninety minutes in contrast to the normal time of between 180 and 300 minutes. In cases where the time was less than 40 minutes there was a complication of some sort, as extreme intra-abdominal bleeding, or secondary infection with abscess. He maintains that all cases with suspicion of tubal pregnancy in which the sinking time is less than forty minutes, may be looked upon as an acute inflammatory process. According to Smiley (87) the test is invaluable in the diff-

erential diagnosis between ectopic pregnancy and diseases of the adnexae. A correct diagnosis is often beset with many difficulties, and errors are frequently made. Other factors being equal a rapid rate of sedimentation points rather to adnexal conditions. By exclusion a slow rate of sedimentation would tend to confirm a diagnosis of an extrauterine pregnancy.

Smiley (87) also finds the test useful in differential diagnosis and treatment of pelvic tumors. In uncomplicated pelvic tumors such as myomas or ovarian cysts the rate of sedimentation remains normal. In the presence of acceleration there may be present an anemia from long continued even though slight hemorrhage, and the hemoglobin count may be of aid in determining this factor. Where the presence of extragenital infection can be ruled out a decided acceleration of the rate usually bears evidence that a softening or degeneration is taking place in the tumor, even before any change is noted in the temperature and leucocyte count. With a rapid increase in the rate time the importance of recognizing the cause is apparent. The test therefore becomes of considerable value in determining whether or not a tumor in the pelvis is undergoing any change that may prove dangerous to the welfare of the patient. It happens occasionally that

some difficulty arises in differentiating between pregnancy, fibroid, and ovarian cyst. Given a patient in whom a pelvic tumor is present, an increased sedimentation rate would give added evidence that pregnancy is the most logical diagnosis. This increase in the rate would be gradual and would correspond to the growth of the tumor, while on the other hand a very rapid increase in the rate would point rather to a tumor with some complication present or impending.

Much has been written about the usefulness of the test in the evaluation of adnexal conditions. The presence of inflammatory processes, their nature and virulence, and the reaction of the patient to such infection can be determined with a fair degree of certainty by the careful consideration of the test it is claimed.

Baer and Reis (4) have found the sedimentation test more useful than the temperature curve or the leucocyte count in determining the presence or abscence of infection. Using the Linzenmeier technique with 180 to 300 minutes as normal they consider that a sedimentation time of more than two hours rules out infection in the existing pelvic pathology. They also use the test as a guide in choosing the safe time for operation, using 60 minutes as the lower limit of safety.

Grodinsky (41) believes that the lower limit of safety is 30 minutes. Patients operated upon with a sedimentation time between 30 and 60 minutes usually have a stormier convalescence but may be considered safe.

Simunich (86) maintains that the presence of virulent organisms is one of the most important causes of postoperative morbidity but an increase in sedimentation speed is due to some other factor than the virulence of organisms. He concludes this from 132 patients operated for adnexal disease using signs other than the sedimentation rate for time of operation. In 61 or 46 per cent the sedimentation rate was below 60 minutes yet there were no more complications in this group than in those with a sedimentation rate above 60 minutes.

Summerville and Falls (92) from a series of 201 operated gynecological cases feel that the test is of little or no value. This conclusion is based on the fact that in 153 cases, the operation was done when it was distinctly contraindicated by the sedimentation test but indicated according to the clinical findings, temperature, and leucocyte count. There was no mortality in these cases that could be attributed to infection following operation such as septicemia, pelvic abscess, or general peritonitis. Postoperative morb-

idity, complications, and hospital days did not vary from that of 48 operative cases with normal or subnormal sedimentation rates.

Schmitz (84) cannot see that the test has any value as a guide for the safe time of operation.

Polak and Tollefson (74) use the test: 1. in determining the time for elective operations; 2. in prognosticating postoperative complications after the first week; 3. as a criteron for discharging patients. Finally a rapid reading means infection and a normal reading means that infection can be excluded, for "sedimentation never lies"

Yates, Davidow, Putman and Ellman (107) conducted a convincing study on 1700 cases which were not operated upon if the white cell count was above 10,000. The sedimentation rate, white cell count and filament-nonfilament was taken on each case and the results correlated with the extent of the pathology at operation. The findings were: (A) The percentage of accuracy of the white blood count in this study was 67.8 per cent. (B) That of the filament-nonfilament count was 77.2 per cent. (C) The accuracy of the sedimentation rate was 91.4 per cent. This shows the sedimentation rate to be much more accurate in determining the degree of pathology, and that the white blood count is not at all reliable. In prognosis the

sedimentation rate took much longer than the filament-nonfilament and could not be used.

Baer and Reis (2) also believe the sedimentation rate reflects the underlying pathology and have constructed a table with the rates most commonly found in various pelvic conditions.

200 min.	
180	Normal Women
165	
	Sacto-salpinx
150	
	Uncomplicated Myomata
135	
	Salpingitis Isthmica Nodosa
105	
	Ovarian Cyst
90	
	Salpingitis Chronica
50	
	Salpingitis Subacuta
30	
0	Salpingitis Acuta

The literature still is very confusing as to the value of the sedimentation rate in judging the virulence of infection, safe time for operation and as an aid to diagnosis. Perhaps Grodinsky (41) is correct in saying that the lower limit of safety should be 30 instead of 60 minutes. If this was accepted as a standard the argument might end. At the present time it is well to stay on the middle ground and use it when it fits your clinical judgment.

ABDOMINAL CONDITIONS

Its use in the differential diagnosis of various pelvic conditions has been given and in a few cases it may be found very useful. Its use in the differential diagnosis of abdominal and abdominal-pelvic conditions has not been mentioned and will now be taken up.

Grodinsky (41) reports a relatively slow sedimentation time present in acute appendicitis without rupture. In 27 cases the average # was 155 minutes, with variations between 45 and 300 minutes. In the subacute and chronic forms, there were even slower times, averaging 227 minutes, with variations between 51 and 540 minutes. As already noted, in right-sided inflammatory adnexal diseases there are more rapid sedimentation rates. Urinary tract disease also gives a more rapid sedimentation rate as will be found later. Although the total white count and differential count are often valuable in differentiating these conditions from appendicitis, there is still a considerable group of cases in which such counts are either not characteristic or are borderline, making them misleading or valueless in the differential diagnosis. It is in this group particularly that the sedimentation test is often of greatest value in helping establish the true diagnosis. Of course, no diagnosis should be based on a

single finding, but on a combined picture built up by a complete history, a thorough physical examination and indicated laboratory procedures.

In cases of ruptured appendix appendical abscesses and appendicitis with generalized peritonitis much more rapid settling times were noted than in uncomplicated appendicitis, the average for such cases being 27 minutes, with variations between 19 and 39 minutes. Since normal blood counts are sometimes found in such cases, the sedimentation test is often of great value in helping to make the diagnosis.

Lesser and Goldberger (57) confirm Grodinsky's work by a study of 75 cases of acute appendicitis. Despite a definitely high leucocytic count in these cases in which definite acute appendiceal pathology was demonstrated at the operating table they were surprised to encounter a normal sedimentation reaction. Such pathological states as catarrhal, suppurative, or gangrenous appendicitis caused no deviation from the normal sedimentation reaction. The only forms of appendiceal pathology giving abnormal sedimentation reactions were those of well established abscess, or generalized peritonitis of appendiceal origin. On the other hand, all other conditions producing the clinical picture of the acute surgical abdomen showed a

definitely abnormal sedimentation reaction.

Smith, Harper and Watson (88) in appendicitis, find the sedimentation rate slow during the first 24 to 48 hours but that it increases after that. They emphasize that the value of the test after this time is very much lessened in the differential diagnosis. They explain this delayed increase in rate on the basis that infection is present in other conditions for a varying length of time before symptoms are produced but in appendicitis the first sign of infection produces symptoms.

Grodinsky (41), Waugh (99) and Linton (58) have all found that in chronic cases of cholecystitis and cholelithiases the sedimentation rate is only slightly increased but in more acute cases with fever, with or without jaundice rapid rates were noted. The presence of jaundice doesn't make any difference according to Linton and Grodinsky but Waugh believes it increases the rate. Rosenthal and Blowstein (80) in their study of the sedimentation test in jaundiced patients found it increased in all but catarrhal jaundice and so conclude that the jaundice is not the cause of the increase in sedimentation rate.

UROLOGY

Wehrbein (100) gives the results of Walther Pewny of Vienna of sedimentation tests applied to his urological service. Acute and chronic urethritis give no increase of sedimentation velocity unless an acute prostatitis, epididymitis, cystitis or bartholinitis has been added. These complications, however, running a chronic course as also strictures and fistulae, give negative results. The positivity of the test in cystitis is proportional to its severity but independent of its etiology. Cancers of the bladder give rapid sedimentation, as, unfortunately, do also benign papillomata where hemorrhage or cystitis is associated. Turning now to prostatism, we find negative results, i.e., no acceleration of sedimentation velocity, in uncomplicated prostatic adenoma in the first or second stage, or beginning third stage; however, as soon as cystitis or hemorrhage complicates the condition, rapid sedimentation occurs. The rapidity of sinking in pyelitis is proportional to the severity of the inflammation and slows as the urine clears. Stone of the kidney or ureter and hydronephrosis give negative results if no inflammation or bleeding has occurred. The clerity of sedimentation in renal tuberculosis runs parallel to the extent of caseation and destruction of tissue.

Hypernephroma gives positive, mobile kidney negative, tests.

Pewny therefore recommends the test for differential diagnosis of adenoma from carcinoma of the prostate, in renal calculus, hydrohephrosis, and mobile kidney from hypernephroma, pyelitis and tuberculosis.

Grodinsky (41) also notes that in acute infections of the urinary tract, such as pyelitis, pyelonephritis, pyonephrosis, prostatitis, and perinephritic abscess, rapid sedimentation times are noted without exception. On the other hand, ureteral colic (stone) and other urologic conditions without associated gross infection are accompanied by fairly normal sedimentation times, emphasizing the importance of the latter in the differential diagnosis of pain in the lower right quadrant of the abdomen.

ARTHRITIS

Dawson, Sia, and Boots (19) carried out observations on 95 cases of rheumatoid arthritis, 73 of osteoarthritis and 28 cases of nonarticular rheumatism by Westergren's technique by which 12 mm. in one hour is normal. Their results were as follows:

	No. cases	Per cent
1. RHEUMATOID ARTHRITIS--		
a. Values above 30 mm.	59	62
These cases were distributed as follows:		
"active" cases	54	56.8
"arrested" cases	5	5.2
b. Values below 30 mm.	36	38
These cases were distributed as follows:		
Old, arrested or "cured"cases	25	26.2
Totally cured	2	2.1
Very early cases	2	2.1
Apparently active cases	7	7.3
2. OSTEOARTHRITIS--		
a. Values above 30 mm.	7	9.6
b. Values below 30 mm.	66	90.4
3. NonARTICULAR RHEUMATISM--("Fibrositis," "Myositis," "Neuritis," etc.)--		
a. Values above 30 mm.	0	0.
b. Values above 12 mm. (normal)	6	21.4
c. Values below 12 mm.	22	78.5

Comparison of Averages:

a. Rheumatoid arthritis	43.3 mm.
b. Osteoarthritis	14.5 mm.
c. Nonarticular rheumatism	8.7 mm.

They summarize their article as follows:

1. In active cases of rheumatoid arthritis the sedimentation rate of the red blood cells is, as a rule, greatly elevated, usually attaining values exceeding 30 mm. in one hour.

2. In rheumatoid arthritis the sedimentation rate parallels to an extraordinary degree the severity and extent of the arthritic process.

3. Exacerbations are almost invariably attended by an increase, and remissions by a decrease, in the sedimentation rate.

4. In old, long-continued and arrested cases the sedimentation rate tends to return to normal values.

5. In cases of osteoarthritis, on the other hand, the sedimentation rate, while as a rule slightly elevated, rarely attains values greater than 30 mm.

6. All cases of nonarticular rheumatism show a normal or only very slightly elevated sedimentation rate.

They conclude: the distinct clinical value of the determination of the sedimentation rate of the erythrocytes is clearly indicated in the differential diagnosis of rheumatoid and osteoarthritis. It must be emphasized, however, that the test should never be relied upon as the sole criterion in the differential diagnosis of the two conditions. This differentiation can usually be made on clinical grounds alone. The determination of the sedimentation time of the red blood cells usually confirms the diagnosis and contributes information of considerable prognostic value in the clinical study of the disease.

Rawls, Gruskin, Ressa and Jordan (76) are of the same opinion as the above authors but warn that intercurrent and focal infections adversely affect the sedimentation rate, and their presence must be excluded before changes in the test may be attributed to variations in the activity of the arthritic process. The significance of focal infections in changing the rate is denied by Lintz (59) who finds that chronic sinusitis, chronic tonsillitis and chronic infections about the roots of teeth do not cause an increase in the sedimentation rate above normal values.

Kahlmeter (52) says that in degenerative arthritis (osteoarthritis) the sedimentation reaction is always without exception found to be normal. This is not in agreement with other workers who find a slight increase.

Weiss (102) also finds the sedimentation rate in cases of infectious arthritis to be very high and that usually it does not return to normal, unless the cause can be discovered and removed. The sedimentation test does not differentiate the various types of secondary arthritis such as tuberculous, gonorrheal or acute arthritis deformans. Waugh (99), however, finds it useful in differentiating early tuberculosis, where the reading is positive, from osteochondritis, floating cartilages, old fractures, rachitic conditions, flat

foot, etc., which give normal results.

Kahlmeter (52) stresses the use of the sedimentation reaction in rheumatic fever. He has used the test for five years and teste an average of 1000 cases each week by the Westergren technique. He finds acute rheumatic fever gives very high values for sedimentation reaction during the most acute stage, about 100 to 120 mm. in an hour. If recovery takes place the figures are usually reduced in the course of a few weeks, subsequently reaching fully normal values. In some cases this decline takes place rapidly, and in almost a straight curve downwards. The curve often falls moderately quick during the first weeks, then rapidly during a few weeks, and, lastly, again more slowly. In other cases it takes several weeks before the curve begins to fall, after which it declines in an even manner. A characteristic feature is that the values of sedimentation reaction do not reach a normal level until the patients have been afebrile for a long time, and usually also clinically quite free from symptoms. Thus we get a "lagging behind" of the sedimentation reaction values. In his opinion the greatest importance of sedimentation reaction in acute rheumatic fever lies in the fact that by this reaction you have far greater possibilities to decide when a certain case of rheu-

matic fever has recovered than by any other clinical method of examination. One is not justified in considering a case of acute rheumatic fever as having recovered, until the sedimentation reaction value has reached a normal level. It happens, not infrequently, that a patient after having been free from fever and clinical symptoms for some time, but with the sedimentation reaction not yet normal, all of a sudden gets an exacerbation of the disease with fresh joint symptoms and an increase of the sedimentation reaction values.

It also would seem to be of value for deciding when physiotherapy should be begun. Every experienced clinician knows how difficult this may be, and that a too early recourse to such treatment may lead to a flare up of the trouble. In cases that run a favorable course in a few weeks, it is, in his experience, wise not to commence any physical therapy until the sedimentation reaction has reached normal figures. In more drawn out cases, such treatment may be commenced cautiously if the sedimentation reaction shows a steadily falling curve and has come down to values of twenty to thirty mm.

In cases of subacute rheumatic fever, Kahlmeter (52), the sedimentation reaction shows, as a rule, during the

first weeks, values of sixty or eighty mm., but even values of 100 mm. and above may occasionally be obtained. In these cases the sedimentation reaction curve runs, on the whole, a similar course as in the acute cases, though more drawn out.

Weiss (102) from 150 cases of rheumatic fever also found that sedimentation rate was high and that it did not return to normal with the disappearance of the arthritic symptoms. The return to normal did not occur until three to seven weeks after the disappearance of complaints. The sedimentation rate did not parallel the severity of the joint manifestations nor the severity of the case. He concludes: this procedure is of no diagnostic value in arthritis, but is of great help in prognosis and an essential guide in treatment and convalescence. No rheumatic fever should be discharged from close observation until the sedimentation rate has reached normal. Any case that simulates acute rheumatic fever but which shows no tendency for the sedimentation rate to gradually return to normal can be understood to be one of secondary arthritis.

According to Elghammer (24) uncomplicated chorea, clinically regarded as a manifestation of active rheumatic infection, does not give an increase in the sedimentation rate. This may suggest that chorea is an

expression of the damage of a previous rheumatic infection, or it may cast some doubt as to the true etiology of chorea.

PSYCHIATRY

Goldwyn (36) gives some very excellant views on the use of the sedimentation test in psychiatry.

Even though we realize there is a great prevalency of somatic disorders amongst the insane, yet it is not an easy matter to detect these conditions. One reason for this is that very often satisfactory physical examinations cannot be made due to the patient's lack of cooperation.

As a rule, psychotic individuals are fairly cooperative for physical study; however, there are very many who are not. For example, it is almost an impossibility to make a competent examination of acutely disturbed or maniacal patients; they are too excited, too noisy and too restless. In cases of involutional melancholia, especially where there is marked agitation, physical examinations are frequently unsatisfactory; the patients are too disturbed for cooperation. Often in studying cases of dementia praecox, especially the catatonic types and the hebephrenic type, we are confronted with the same difficulty.

Then, again, not uncommonly are the patients so engrossed in their hallucinations and delusions that they fail to make subjective complaints of their physical disorders. Because of this, very commonly early

diagnoses of somatic diseases are not made.

Also, in cases where there is marked mental deterioration patients do not know enough to report their subjective symptoms; therefore, it is not until late that a disease is detected.

In this article we are recommending a certain laboratory test, the erythrocyte sedimentation reaction to be used as a routine procedure in psychiatric institutions. This test has been of practical aid in detecting the presence of many somatic disorders, especially in dealing with uncooperative patients. It has been of some value in medical and psychiatric diagnosis and differential diagnosis; also it has proved to be helpful in determining the physical and mental clinical conditions of patients.

In a series of over two hundred cases done at the Worcester State Hospital Goldwyn came to the following conclusions:

1. The acceleration of the erythrocyte sedimentation reaction varies with the amount of mental deterioration, the amount of organic destruction, and the amount of toxicity present, directly.
2. Unless complicated by physical diseases, the sedimentation reactions are normal in cases of maniac depressive psychoses, psychopathic personalities,

psychoneuroses, and paranoia.

3. Increased readings are found in all cases of senile psychoses, psychoses with cerebral arteriosclerosis, general paralysis, neurosyphilis, psychoses with mental deficiency, psychoses with somatic disease, acute types of alcoholic psychoses, in many cases of epileptic psychoses and involutional melancholia.

4. In dementia praecox the findings in the simple and paranoid types tend to give normal readings, while the hebephrenic and chiefly the catatonic types tend to give slightly accelerated reactions. Cases with marked mental deterioration give increased readings. No cases of dementia praecox gave a marked increase unless complicated by some physical disorder.

5. The sedimentation reaction is of limited aid in psychiatric diagnosis.

6. Repeated tests are helpful in determining the clinical condition of the patient.

7. Because the sedimentation test is a reliable and efficient indicator of many somatic diseases, it is of most practical value in dealing with psychotic patients.

Freeman (27) finds normal values in schizophrenia.

No emphasis has been put on the use of the sedimentation rate to differentiate functional from organic disorders that similate each other. Walton (98) mentions that in functional disorders the sedimentation

rate is normal. Cutler (19) includes functional diseases in his list of those not influencing the sedimentation rate. Goldwyn (36) does not specifically mention that functional diseases do not affect the sedimentation rate but such seems to be the case.

To me it seems that often the sedimentation test could be put to use to determine if the patients symptoms were the result of actual underlying pathology or an escape mechanism.

ALLERGY

The value of the sedimentation rate in allergy is still a much debated question. Schuloff (85) concludes from his study on 610 nonselected cases that a pathologically slow rate is found almost constantly in patients with allergic conditions and that a rapid or even normal sedimentation rate is indicative of the presence of a more or less serious disease complication. Ellis (23) also finds the sedimentation slow in allergy.

Uffee (95) from his 150 allergic subjects found that only 9.3% showed an abnormally slow sedimentation rate. He came to the conclusion that a mormal sedimentation rate in allergic patients is not indicative of the presence of a more or less serious pathologic complication.

Westcott and Spain (103) concluded that the erythrocyte sedimentation rate in uncomplicated noninfective asthma, hay fever, or allergic nonseasonal coryza, falls within the accepted normal limits and particularly in hay fever toward the low normal limit. It is, therefore, of little value as a test in purely allergic conditions.

Gelfand and Victor (34) in 63 hay fever subjects

found only one showed a slow sedimentation rate. The rate remains normal during the hay fever season and treatment with pollen extracts produces no effect whatsoever on the rate. They conclude therefore that the sedimentation rate of the red blood cells in patients with hay fever who present no other pathologic complications of a destructive nature remains normal before as well as during the hay fever season and whether they receive treatment or are without treatment.

HEART DISEASE

Wood (106) studied 164 cases of heart disease and obtained the following results:

1. Congestive heart failure retards the sedimentation rate regardless of the cardiac pathology, and may therefore mask activity of the disease process. The mechanism is not clear, but various factors may play a part because cyanotic states retard the sedimentation rate and there may be a lowering of the plasma fibrin in congestive heart failure.

2. Increased sedimentation rates are found in cases of active rheumatic carditis, syphilitic aortitis, and myocardial infarction. The readings approach normal as the condition improves.

3. The sedimentation rate is also increased in cases of infective endocarditis and malignant hypertension, but the test is of little value in these conditions.

4. Angina pectoris of effort, apart from syphilitic cases, is associated with a normal sedimentation rate; angina of rest usually with a somewhat increased rate. Increased after the first day or two in coronary occlusion to a high at about the end of the third week and then decreases to normal as healing takes place.

5. Normal sedimentation rates are found in cases of

inactive rheumatic heart disease and of atherosclerosis.

6. In subjects with hypertensive heart disease, the sedimentation rate may be normal or slightly increased.

7. Pulmonary infarction increases the sedimentation rate.

8. In the absence of cyanosis, cases of congenital heart disease are associated with a normal sedimentation rate, but with marked cyanosis the rate is abnormally slow.

9. Mild cases of thyrotoxicosis in which cardiac symptoms predominate are associated with normal sedimentation rates.

In sixteen cases of coronary thrombosis Hoffman (46) found the sedimentation rate elevated in every case. He did not find the degree of increase of the sedimentation rate to be an index of the severity of the injury but did find that when the sedimentation rate returned to normal healing of the infarction had taken place.

Rabinowitz, Shookhoff and Douglas (75) from 10 patients with acute coronary occlusion discovered that the sedimentation time was definitely shortened in all. It appeared later in the disease than fever and leucocytosis but persisted for a time after fever and leucocyte count were normal thus being a better index of the progress of the healing.

PEDIATRICS

The sedimentation rate has also been applied to pediatrics. Its main application has been in rheumatic fever which has been previously discissed under arthritis.

S. Friedman (30) has reported its use on fifty-five cases of scarlet fever. He found the curve of the sedimentation rate varied with the mildness or severity of the case and that complications were manifested by a rise in the sedimentation rate. He could not draw any definite conclusions as to the effect of convalescent serum or antitoxin on the sedimentation curve.

Cookson (15) on the other hand found that the sedimentation rate taken early in scarlet fever did not for-tell which cases would develop complications but since most complications occurred between the 14th and 24th day of the disease it was useful to test on the 14th day. If the rate was low, one would know that probably the patient would have no complications, whereas if it were unduly high, one should watch the case with some care. Most complications which occur in scarlet fever cause a raised sedimentation rate before they give symptoms and signs, and also while the com-

plication lasts. The exceptions are benign albuminuria and serum reaction.

Gallagher (33) has found that mumps and the common cold and other minor infections such as these affect the rate slightly if at all.

In whooping cough according to Gold and Bell (35) the sedimentation time has no value in the catarrhal stage but in the paroxysmal stage of uncomplicated cases 94% show a retarded sedimentation time to agree with the results of other workers in Europe. Therefore in the paroxysmal stage of atypical cases it is often of value in making the diagnosis. In the period of decline the test has no value.

Walton (98) agrees with Wolf that gastro-enteritis of an infectious origin gives a markedly rapid sedimentation rate, while, if of alimentary origin a normal figure is found.

The finding of a rapid sedimentation rate in the new-born or in the apyretic young infant who may merely show a lack of normal development, will speak for hereditary syphilis, even in the face of a negative Wasserman.

Kahlmeter (52) has summarized the use of the sedimentation reaction very well. The sedimentation reaction has proved to be of very great importance from the diagnostic as well as prognostic and therapeutic point of view. Its importance from the diagnostic viewpoint is not that any particular disease can be diagnosed by means of this reaction because, of course, it is not specific. However, it must be realized that, in case of an increased rate of sedimentation, this is an indication of the absence of certain diseased conditions (not causing increasing sedimentation)--unless, of course, two disease processes are coincident. For example, in a case of sciatica or heart lesion, a gastric ulcer or enterocolitis, should an increased rate of sedimentation be found, it may be concluded with great certainty, either that the diagnosis has been wrong or that there exists some other underlying complicating condition occasioning the increased sedimentation. It is clear, therefore, that the sedimentation reaction is of no mean import as a guarantee against pitfalls in diagnosis.

The second factor of importance as regards the sedimentation reaction He mentions is its value for prognosis and treatment. To avoid misunderstanding He wishes to emphasize at once that a single examination of

the sedimentation reaction gives us no information whatsoever as to prognosis (e.g., in pulmonary tuberculosis or chronic arthritis). On the other hand, by serial examinations information can be gained about the prognosis as well as the effect of the therapy in such important conditions as those mentioned above.

CONCLUSIONS

1. Rapid sedimentation is found only in infectious disease and malignancy. It is due to tissue destruction above the normal amount. Normal tissue destruction varies from day to day and so does the sedimentation rate in normal individuals.

2. As an aid in estimating activity of a tuberculous lesion the sedimentation test is more reliable than temperature curve, pulse rate or gain in weight, the three major guides in the treatment of tuberculosis. Thus it is a very good guide in treatment and prognosis of a tuberculous patient.

3. The sedimentation rate is of questionable value as a guide in choosing the safe time for operation in pelvic inflammatory disease. The bulk of the evidence lies in favor of the use of the sedimentation test in this connection. It has limited value in differential diagnosis and prognosis in gynecology.

4. Valueless as a diagnostic test ~~in~~ of early pregnancy.

5. The test is frequently valuable in the differential diagnosis of lower right quadrant pain.

6. The test is frequently of value in differentiating rheumatoid and osteoarthritis. Also it reflects the results of treatment.

7. In rheumatic fever the test is of value as a guide in therapy. When the sedimentation rate is normal exercise can be permitted.

8. In psychiatry it is useful to detect somatic disorders and has slight value in the differential diagnosis of mental disorders.

9. The test may be of some value in differentiating organic from functional disorders that simulate each other.

10. The sedimentation test has no value in allergy.

11. In acute coronary occlusion the return of the sedimentation rate to normal may be used as a guide in the healing of the infarction.

12. Sedimentation rate taken on the 14th day in scarlet fever often predictes complications before they appear clinically.

13. Sedimentation of erythrocytes may be useful at times to diagnose whooping cough in the paroxysmal stage.

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