

per cent. of the cases operated on have been Italians, notwithstanding which he has observed less improvement in them than in others.

The class of cases demanding this operation comprises those in whom there is nearly a complete retention of urine and the patient has to depend almost entirely on the catheter, also those with the tenesmus and irritability of the bladder so great that catheterization and washing out of the bladder are not able to relieve it; again, when the cystitis is very marked or troublesome, and when hematuria is a frequent symptom. An increasing amount of residual urine is another urgent cause, or when catheterization is followed by hemorrhages or bad attacks of cystitis. The cases in which it is contraindicated are where the kidneys are badly diseased, medically or surgically, or where arteriosclerosis is marked and where the heart action is weakened through valvular or fatty changes.

The question of anesthesia is an important one. The writer does not think that either cocain or eucain relaxes spasm sufficiently, and, besides this, he is sure that most patients suffer considerably when operated on under their influence. Cocain is also said to be dangerous, and eucain in one case was found to have produced syncope. Of the general anesthetics, ether is bad for old men whose kidneys are at fault, and chloroform is bad for the heart. This has led the writer to give nitrous oxid gas in a number of his cases. The patient is put under quickly and comes out almost immediately. The danger in the hands of a man who understands its administration is *nil*.

In Colton's Dental Bureau, in Cooper Union, N. Y., it has been given over two thousand times without an accident. The patients have at times been kept under its influence for over two hours. It can be given on a full stomach.

In the ordinary operation three cuts are usually made. The first one is always posterior, the two others are on either side in cases of lateral lobe hypertrophy. In cases where the enlargement is irregular and situated principally in the middle lobe, the second incision should be anterior and the third through the larger of the lateral lobes. The posterior incision is usually 3 cm., the anterior 2 cm. long and the lateral 2.5 cm. The time for each cut is usually eighty or ninety seconds, and the strength of the current from forty-five to fifty amperes.

Immediately after the operation the patient may be allowed to pass water, if he desires, and he should be put to bed. Patients are generally able to walk from the table to their beds, although it is safer to carry them.

The internal treatment consists in urinary antiseptics, diluents, and antispasmodics, if necessary. As a diluent, water taken in large quantities is usually sufficient. If it is found, however, that the patient will not drink much, and that the amount of urine passed is below normal, its flow should be further stimulated by a mild diuretic, and for this purpose I am in the habit of giving a mixture of acetate of potassium, sweet spirits of nitre, three times a day in a glass of water. As a urinary antiseptic, I generally give salol in ten-grain doses three times a day, or urotropin in the same strength, the latter preferably when the urine is foul and ammoniacal. Benzoate of sodium and benzoic acid in fifteen-grain doses are also of service.

The antispasmodics are codein, morphin and belladonna. Those are given for frequency, pain, tenesmus or burning. They may be prescribed singly or com-

bined, and afford the patient a great deal of relief. Codein may be given alone or in combination with belladonna, and perhaps benzoate of sodium. Morphin is rarely used, and then only for pain. It is very efficacious in combination with the extract of belladonna, a quarter of a grain of each, in suppositories at night, in cases where there is considerable frequency, pain, burning, and tenesmus. The diet should be liquid for the first few days, then semisolid—soft—and full diet at the end of the week, if the patient has no rise of temperature and is feeling well.

If retention of urine occurs, as it frequently does, a catheter should be passed into the bladder and allowed to remain for twenty-four to forty-eight hours. On withdrawing the catheter, if the patient is still unable to pass much urine, he should be catheterized regularly until the sloughs have been passed, when, if he is still unable to urinate, a second operation should be performed. If the patient has complete retention and nothing can be passed into his bladder, he should either be aspirated suprapubically, or a perineal section performed.

If there is much hemorrhage, it can usually be stopped by a hot irrigation, and if not, a perineal section should be performed, after which a thick-walled perineal tube can be inserted into the bladder, around which gauze can be packed, thus making pressure between the sides of the tube and the cut posterior urethra.

The bowels should be moved by salines on the second day, after which they should be kept open for some days.

An elevation of temperature usually takes place on the night after the operation or on the following day, rising from 100 to 105° F. This rise generally goes down to normal after the bowels have been moved, but I have seen cases with a temperature of from 99 to 102° for some weeks after the operation. In such a case the fever usually disappears after the sloughs have been thrown off.

Where the bladder and the kidneys are very much involved a continuous temperature may indicate a disease of the latter organs, which should then be treated accordingly. Extravasation of urine and perineal abscess may occur, but it is improbable, as the tissues are practically seared and sealed by the burning process.

ESTIMATION OF HEMOGLOBIN.*

A COMPARISON OF THE VARIOUS METHODS.

BY B. M. LINNELL, M.D.

CHICAGO.

Most of the effort heretofore to arrive at an estimation of hemoglobin in blood has been made by means of the various color tests. These tests have multiplied until the catalogue of the various instruments resembles the list of "sure cure" remedies for the hives. This fact alone shows a dissatisfaction on the part of the clinician with the results obtained by the various color methods. The two instruments with which we are most familiar in this country are Von Fleischel's hemometer (the German), and Gower's (the English instrument.) The use of these instruments has demonstrated the sources of error as enumerated.

1. In color tests in general:

a. Two eyes rarely agree in accurate estimation of varying shades of color, thus producing individual variations.

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b. Eyes of the same individual vary at different times, due to fatigue and influence of varying intensity of light.

I have made a test of 425 cases with students examining Fleischel's hemometer. The apparatus was prepared and placed where each student made the color comparison for himself without the knowledge of the other. The variations between the various readings were about 20 per cent. Thinking this error might be due to the inexperience of the observers, I made the test at a meeting of medical men, most of whom were accustomed to the use of the hemoglobinometer. The readings were as follows: A, 35; B, 39; C, 50; D, 48; E, 32; F, 30; G, 35; H, 39; I, 35; J, 42; K, 35; highest reading, 50; lowest, 30; average, 38.2; largest number of agreements of reading at 35, four. Two of the readers, F and J, are frequent users of this method, and their readings differed 12 per cent. The greatest variation was 20 per cent., the same as obtained by the students. A part of the error is accounted for by the limitations of the color test and part by the inaccuracies of the instrument used (Fleischel's).

The variations of the same eyes at different times is easily demonstrated by the observer making several readings of the same specimen, covering up the indicator while doing so each time. In my own case I have found variations of 10 per cent. with different readings of the same specimen. I have oftentimes found errors of like observation in others accustomed to use the hemoglobinometer.

2. Fleischel's instrument:

a. The errors common to color tests.

b. The normal standard of hemoglobin as represented by the instrument is too high for healthy American subjects; 80 to 85 per cent. represents nearer the normal of healthy male lives between the ages of 20 and 30, as indicated by Fleischel's instrument in this country.

c. The quantity of blood used in the test is so small that the least amount of variation in quantity used causes a great amount of variation in percentage. A difference of percentage results with a bulging or depression of the blood at the ends of the capillary tubes.

d. The area over the glass wedge under observation represents a variation of 20 per cent. The middle of the field must be picked out to obtain a correct estimate.

The above considerations have to deal entirely with the sources of error. The objections to the use of the instrument are the cost of the instrument and the necessity of using artificial light in the comparison.

3. Gower's instrument:

a. Errors common to color tests.

b. The colors of the standard tube and the hemoglobin solution are not always the same, and sometimes can not be brought to be the same. The hemoglobin often has a grayish-pink color, while the standard solution is more of an amber-pink to my eye. This makes great difficulty in comparing the shades. It makes it impossible in some cases to make an estimation of the hemoglobin.

c. In adding water to dilute the hemoglobin, one is apt to overdilute the solution, thus making it necessary to repeat the test.

d. One cannot make a number of estimates of the same specimen and strike an average.

It has the advantage of the use of a large quantity of blood, thus diminishing this source of error. The surface for comparison is larger and more uniform. The tests can be made by either natural or artificial light. It is a much cheaper instrument.

A rough method of estimation, which is a good one, is by comparing the patient's blood on a towel, hand-

kerchief or white filter or blotting paper. This has the disadvantage of the general color test, and no table of comparison, but is easily and quickly made, and will be explained more in detail later on.

There is evidently a need for a more mechanic method of determining the percentage of hemoglobin. This seems to have been found in Hammerschlag's method, which consists in placing a drop of blood in a solution of benzol and chloroform. Add one or the other of the solutions to the mixture, as the drop floats or sinks, until it remains stationary in the center of the solution; then the specific gravity of the mixture will be that of the blood. This is a modification of the method of Roy, who used a number of bottles of salt and water graded from 1025 to 1075. Lloyd Jones elaborated this method, using glycerin and water, and had a case made containing twenty bottles of solutions of different specific gravity, which he called a hemobarometer. Owing to its simplicity, Hammerschlag's method has come into more general use. This is the method used in my experiments. The normal specific gravity, as determined by Hammerschlag, is 1060.5 in healthy males of adult life. As shown by the tables in 28 observations made on 8 different persons, the average is 1060.3, the maximum observation being 1065, and the minimum 1056. The specific gravity in females is lower. In the 3 cases tabulated the maximum specific gravity is 1059.5; minimum, 1055; and average, 1057.5. The ages are all between 21 and 55, only one above 33.

In order to ascertain the amount of variation which takes place during a day under ordinary conditions, I made 17 tests on a male subject 21 years of age and in good health, during sixteen hours. The tests began at 8:30, after a breakfast, one hour previous, consisting of 1 cup of coffee, 2 slices of bread, 1 dish of rhubarb. As seen by the table, the highest sp. gr. was 1065, taken at 8:30 a. m. The next specimen, taken at 10 a. m., was 1061. I have reason to believe the first test was wrong, as it did not reach such a high mark at any other time during the day. The most of the estimates were about 1061. Dinner, with 1 glass of water, 1 cup of coffee, and 6 oz. of water one hour later as fluids, was followed by no marked fall of sp. gr. The lowest point was reached at 5:30 p. m., and was 1058. After this test the subject took a half hour's spin on a bicycle, in the open air, coming back in a mild perspiration. The hemoglobin was found to be 1063. This was the greatest change during the day, a rise of 5 points. At 9:30 p. m. observations were resumed; sp. gr. 1061. The subject drank 18 oz. of water after test, which was followed by a fall of 1 point, to 1060, but returned to 1061 in two hours. The general average of the readings for the day was 1060.8. The blood count at 3:10 p. m. was 5,600,000; hemoglobin, Gower's, 96 per cent. The variations under normal circumstances are very slight, only 2 to 4 points. These observations were made at different points about town after riding, walking, sitting quietly, eating and drinking.

I now present a table showing a comparison of the sp. gr. with tests for hemoglobin and the counts of red blood-corpuscles, both in health and disease. It will be noted that the sp. gr. varies more with the variations in percentage of hemoglobin than with the corpuscle counts. In Case No. 2 is this especially true, the reduction due to secondary anemia, a case of pulmonary tuberculosis. The examinations were made at the same sitting, but the blood was taken from different locations on the body, namely, lobe of ear, great toe and finger. The sp. gr. varied 7 points, but so did the other esti-

mates in about like proportion. The variations were probably due to the fact that the blood did not flow so freely from the toe and ear as from the finger.

In Case No. 1, a normal, healthy subject, the difference is not so marked, only 1.5 points. The hemoglobin percentages did not vary so much, while the counts vary about the same as in Case No. 2.

In Case No. 3 the sp. gr. was 1044.5, while the five hemoglobin readings varied from 37 to 47, all made by different persons and with the same specimen, except one reading by Gower's method, which was 40 per cent., the average of all being 40.7, corresponding closely to Hammerschlag's table.

In Case No. 4, one of chlorosis in which the count was not recorded, the sp. gr. was 1046, and the average hemoglobin percentage 49.7 per cent. (Fleischel's), which again corresponded closely to the table. In Case No. 2 the average of the sp. gr. tests was 1051.3, the hemoglobin, 70.8, and count 4,300,000 reds, the sp. gr. being a little lower than the corresponding hemoglobin percentage in the table.

In taking the sp. gr. I found that a great saving of time was accomplished by having the necessary apparatus collected and kept together in the following described case, and in bedside examinations some such arrangements is quite necessary to secure the best results.

The apparatus consists of an ordinary urinometer and flask, 3 bottles with cork stoppers, one each containing chloroform, benzol, and a mixture of the two, 2 simple pipettes, a stirring rod, a few sheets of round filter paper, a pipette graduated to 20 cm., with rubber tubing and mouth-piece, a glass slide and cover-glasses, one-half-dozen pen-nibs, all arranged in a case with compartments for each article.

In making the test the following points are suggested for obtaining the more rapid and accurate results:

1. All of the apparatus must be perfectly clean and dry, especially the urinometer glass. The drop of blood will cling to the particles of blood or lint left in the glass and often flatten itself against the sides.

2. Before obtaining the drop of blood from the patient the benzol and chloroform mixture should be poured into the urinometer glass and brought to a little above that of the blood as estimated. A rough estimate may be made in two ways: 1. Compare a drop of the patient's blood with that of one of a known sp. gr., namely your own. If the colors differ widely, dilute a drop of your own blood by means of the graduated pipette, using ordinary clean water as a diluent, to about 50 per cent. The mixture can be made on the glass slide which accompanies the case. Compare this with the patient's blood. The sp. gr. of blood with 50 per cent. hemoglobin was about 1045.5. If the patient's blood is lighter than the central specimen diluted to 50 per cent., then the sp. gr. of the chloroform-benzol mixture should be started below 1045.5. If darker, the mixture should be higher. This method is recommended only when the blood seems to be greatly reduced in hemoglobin, and it presupposes knowledge of the per cent. of hemoglobin of the examiner's blood. This method forms a good test for a rough color estimate. By practice one becomes expert in the estimation.

3. The finger is usually selected by us as the most reliable place to obtain sufficient blood with one puncture. The side of the finger is preferred, as the subsequent discomfort is not so great.

4. The best and cheapest instrument for producing puncture is a sharp pen-nib with one point removed. A

new one can be used with each patient, and thus the danger of infection is minimized. The same precautions in regard to not squeezing the blood out must be observed in this method as in all.

5. The mixture should be slightly above the sp. gr. of the blood, if possible, because in adding chloroform it is much easier and quicker to mix the two. As the heavier chloroform passes down through the mixture, it is partially mixed and is easily completed by slightly stirring with the glass rod. The lighter benzol, on being added, drop by drop, remains on the top, and either the urinometer glass has to be placed against the hand and carefully tipped upside-down, which is the better method when needed, or the contents must be agitated greatly with the glass rod in order to procure a uniform mixture.

6. In making estimations, I have found that the percentage of error is greatly reduced by using drops of about 10 cm. I draw about 15 cm. of blood up into the tube and then blow out 2 or 3 cm., wiping it away, then put 10 cm. into the mixture, leaving 2 or 3 cm. in the tube. The first and last portions of the blood are apt to contain either air or the water used in cleansing the pipette. Smaller drops of blood, however, do not vary the results materially if accuracy of technic is observed.

7. In mixing the benzol and chloroform it is much quicker and easier to use pipettes, pouring the solutions in drop by drop. In pouring out of a bottle it is very easy to pour too much and have to go over the process with the other solution. Then, the pipettes are more easily handled. In my laboratory I use bottles with ground-glass caps, with pipettes cut in lengths to suit and kept in the bottle.

8. The best kind of urinometer is one graded from 1025 to 1075. The spaces are wider, hence greater accuracy of reading is obtained. An ordinary urinometer, which is accurate up to 1060, will do, as pathologic conditions are such that readings with a higher sp. gr. are of no special clinic significance. The urinometers should be tested carefully to 1060. Most of them I have found erroneous in the higher numbers of the scale. The urinometer glass should stand firm and have a smooth rim to prevent the leaking of the solution when turned up against the hand.

9. In place of the graduated pipette a "white corpuscle counting" pipette from the hemocytometer may be used, or an ordinary glass tubing drawn out into a pipette. The case is so arranged that the corpuscle counter may also be carried to the bedside and a specimen taken for examination. The contents are prevented from escaping by a rubber band placed about the ends of the pipette. The case is made as small as possible, compatible with convenience and accuracy in its use. It may be obtained from Sharp & Smith, instrument makers, Chicago.

We need a system of estimating hemoglobin which will eliminate the necessary inaccuracies of color comparison.

The tests seem to show that the sp. gr. varies with the percentage of hemoglobin. Variations under normal conditions in blood are not great enough to interfere with the value of the sp. gr. test. Hammerschlag's is mechanically accurate and eliminates the necessary errors of color comparisons. The errors made in taking the blood are common to both methods.

DISCUSSION.

Dr. JUDSON DALAND, Philadelphia—So far as the color

tests are concerned, I believe the reader of the paper is correct when he states that all are objectionable. A certain percentage of error in the use of von Fleischel's instrument can be reduced. I have come to the conclusion that very frequently, in making our comparison by looking through the entire field of the cylinder of distilled water and diluted blood, the attempt to cover this broad surface in one view causes a certain percentage of error. About a year ago, at a meeting of the Philadelphia Pathological Society, I suggested that a cap be placed on the cylinder, containing a slit measuring one-eighth inch in width, made of any material, which would limit the field of observation, and thus reduce some of the errors of the instrument. Another error to be overcome is the distance at which the eye is held from the instrument; a distance of eight or nine inches is the best. A number of other interesting sources of error regarding von Fleischel's instrument might be mentioned, but time will not permit. I agree with the reader of the paper that we do not usually get 100 per cent. of hemoglobin; the percentage is usually lower.

It is also well to remember that if two pipettes or more be used, the reading will be more accurate in cases where the percentage of red blood-corpuscles is less than 50. Gower's instrument is seldom employed; it is subject to a wide range of error. Occasionally the colored tube of gelatin is decolorized in the course of time.

As regards the method described, I have had no personal knowledge as to its use. The percentage of blood pigment as determined by various methods differs greatly. From a long series of observations extending over a considerable period of time, it is necessary to determine which method is the best. The translation of the hemoglobin percentage is subject to considerable variations taking place in the plasma, but this percentage is not very great; it is exceedingly limited. Although it is true that the specific gravity of the blood is chiefly due to its contained hemoglobin, the plasma also contains substances that vary in disease. It is therefore manifest that the specific gravity of the blood should not be considered as the exact equivalent of the amount of blood pigment present.

Dr. GEORGE DOCK, Ann Arbor, Mich.—I would like to corroborate everything the reader has stated regarding the advantages of the specific gravity method. It is easy to carry out. It must be borne in mind, however, that the specific gravity does not always correspond to the amount of hemoglobin present. A large amount of comparative observations with the specific gravity test and von Fleischel's hemometer have shown that hemoglobin chiefly affects the specific gravity, and there are few cases in which the readings do not correspond. Gower's method is much more faulty than von Fleischel's. In using the specific gravity method great care is necessary. If the estimation is difficult to make, a fresh drop should be used as a control, for in a trial which takes some time the density of the drop becomes altered by various causes. I have long taught that if one is limited to one method of estimating hemoglobin, Hammerschlag's specific gravity method should be chosen rather than Gower's instrument. The cap devised by Dr. Daland has for some years been a part of Meischer's modification of von Fleischel's instrument, a modification which also does away with several of the other sources of error in the old apparatus. The instrument is expensive, but we can hardly give up the estimation of the coloring matter of the blood, and for that purpose it should be preferred to the old apparatus or to that of Gower. The practitioner can, however, get along very well by the aid of Hammerschlag's method, carefully carried out.

Dr. HORACE B. ARNOLD, Boston—I made quite a number of experiments this spring on the effect of chlorosis on the heart, using the color and specific gravity methods in these cases. The results obtained are important, especially in the case of chlorosis, where the hemoglobin has a low percentage; this might have been due to the heart changes or to error in the color tests. In this case there was particular satisfaction in using the specific gravity method. The comparison made between the color test and the specific gravity method by my assistants showed that they ran close. In considering the cases of chlorosis it is important to take count of the blood-corpuscles, because in some cases we find an improvement in the condition with an increase in the amount of hemoglobin, and an increase in the number of red blood-corpuscles out of proportion to the increase in the percentage of hemoglobin. So in this case apparently there is a diminution in the percentage of hemoglobin.

ANGINA PECTORIS.*

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Pain is so seldom directly associated with serious diseases of the heart that most specialists and practitioners of medicine are wont to treat lightly a patient's anxious inquiry about the heart, and to dismiss the case with no particular guidance or injunction, as one having an imaginary or neurasthenic origin.

Though it has been considerably over one hundred years—1768—since Herbenden gave the name of angina pectoris to a certain affection of the heart, which he declared must be distinguished from ordinary cardiac dyspnea, and a few years later Edward Jenner described some of the morbid conditions, which may be found in this disease, yet there is to-day no one certain and positively accepted statement of the cause of this sudden taking off of a human being, who may have previously complained but little, or not at all, of feeling badly.

Since Herbenden's time nearly all medical writers and clinicians have had something to say of the etiology of angina pectoris. Desportes located the disturbance in the vagus; Laennec in the sympathetic; Jolly in the intercostal nerves; Brouillard in the phrenic nerve; Kirsch in the spinal cord; Piorry and Cahn placed it in the brachial plexus; Romberg, Peter and Lanaceaux in the cardiac plexus; Leyden, Potain and Charcot express opinions not in harmony with each other; v. Basch declares it to be sclerosis of the coronary arteries; Osler says that the disease is associated more particularly with sclerosis of the root of the aorta and changes in the coronary arteries and in the myocardium. Constantin Paul, of Lariboisiere Hospital, acknowledges the frequency of atheroma in patients who have died of angina pectoris, but when he considers the large numbers of patients at Bicêtre and la Salpêtrière, who suffer from atheroma and are free from angina, he can not convince himself that the two diseases bear an undeniable casual relation to one another.

Kinnear believes the disturbance is due to hyperemia of the spinal sensory centers. Anders in his late "Practice" concerning the nature of angina, says: We possess few if any positive data; and conclusive post-mortem evidence in support of the various theories that have been and are advocated is, as yet, wanting.

Theodor Schott of Bad Nauheim, Germany, in a very recent article on the treatment of cardiac neuroses, speaks of: 1, angina pectoris nervosa; 2, angina pectoris vasomotoria, and this complaint he attributes to spasmodic contraction of the vessels, and mentions that besides the disturbances of a nervous character, there exist also other abnormal changes in the heart; 3, a form of angina pectoris he calls vera, and states it is more frequent than the nervosa or the vasomotoria, a statement with which the writer does not believe most practitioners will agree. Musser says angina pectoris in its typical form and in association with diseases of the heart is not of common occurrence. Schott goes on to speak of the difference of the pulse in true angina pectoris, which was not appreciable to the finger and only to be found in sphygmographic tracings and which often indicated arrhythmia, tachycardia and bradycardia. He believes that the most frequent causes of this complaint are arteriosclerosis, chiefly of the coronary vessels, insufficiency and stenosis of the aortic valve, myocarditis, etc.,

*Read before the Medical and Surgical Society of Washington, D. C., April 6, 1899.