and have been plotted in the form of a curve in the accompanying figure. When these values are expressed in degrees Fahrenheit and millibars, it will be seen that the curve of saturation pressures between the temperatures 30° and 90° has a remarkable similarity to the parabola:

$$y = \frac{1}{100}x^2 - \frac{1}{2}x + 12.$$

The greatest error introduced by using this equation occurs in the neighbourhood of 76° F., at which the true value of the saturation pressure is 30.66 millibars, and the value calculated by the equation is 31.76, an error of a trifle over 1 millibar. Elsewhere this error decreases, and at three points over the indicated range the calculated value coincides with the true value.

Using the equation, one may write:

$$S^w = \frac{1}{100}W^2 - \frac{1}{2}W + 12$$

where W is the temperature Fahrenheit of the wet bulb. Hence, from the formula $P = S^w - f\Delta$, and taking $f = \frac{1}{2}$,

$$P = \frac{1}{100}W^2 - \frac{1}{2}W + 12 - \frac{1}{2}\Delta.$$

But $\Delta = D - W$, where D is the temperature Fahrenheit of the dry bulb, and the formula thus becomes:

$$P = \frac{1}{100}W^2 - \frac{1}{2}D + 12.$$

Partial saturation of the atmosphere by water vapour is usually expressed in terms of "relative humidity," which is the ratio of its actual vapour pressure to the pressure which would be attained by saturation at the same temperature, expressed as a percentage. Using the term H for relative humidity, and S^d to express the saturation pressure at the temperature of the dry bulb, one may thus write:

$$H = 100 \frac{P}{S^d} = 100 \frac{\frac{1}{100}W^2 - (\frac{1}{2}D - 12)}{\frac{1}{100}D^2 - (\frac{1}{2}D - 12)}$$

Thus, as may be seen, to estimate the relative humidity the only figures required are the squares of the thermometer readings, each divided by 100 and diminished by half the dry-bulb reading less 12. For example, if the dry bulb reads 60° F. and the wet bulb 55° F., half the dry-bulb reading less 12 will equal 18, and subtracting from each of the squares the relative humidity is found to be:

$$100 \frac{30.25 - 18}{36.00 - 18} = 68\%.$$

If the dry bulb reads 71° F. and the wet bulb 67° F., the relative humidity is found to be:

$$100 \frac{44.89 - 23.5}{50.41 - 23.5} = 79\%.$$

The relative humidity is, however, not a very valuable figure if, as is usually the case, it is desired to estimate the capacity of the air to absorb moisture, since the total capacity of the air varies greatly at different temperatures, and at low temperatures is so small that even a small relative humidity does not indicate a great residual ability to absorb moisture.

For practical purposes the drying capacity of the air is better expressed as the "saturation deficiency," or the number of millibars by which the partial pressure of the water vapour actually present falls short of the saturation pressure at the same temperature. This figure, expressed in terms of the equation, becomes:

$$\begin{aligned} S^d - P &= (\frac{1}{100}D^2 - \frac{1}{2}D + 12) - (\frac{1}{100}W^2 - \frac{1}{2}D + 12) \\ &= \frac{1}{100}(D^2 - W^2) \\ &= \frac{1}{100}(D + W)(D - W). \end{aligned}$$

The above expression, which might be called the "index of drying power" of the air (and approximates the true value of the saturation deficiency in millibars), thus becomes a figure which can rapidly and easily be calculated direct from the thermometer readings without the help of tables, should these not be available. For example, the thermo-

meters might show readings of 50° F. and 45° F. Multiplying the sum by the difference, and dividing by 100, the index of drying power is found to be 4.75. In another place they might show 75° F. and 68° F.; by the same calculation the index is found to be 10.01. In the second case, though the depression of the wet bulb is only 2° F. greater, the air has more than twice the drying power.

Discussion

Wet- and dry-bulb thermometers are rarely seen in operating theatres; but I would suggest that were they more commonly used, and the proposed simple calculation of the index of drying power carried out from time to time in conjunction with readings of the dry bulb, the results might in many cases prove illuminating. The importance of the wet-bulb temperature was long ago pointed out by Haldane (1905), who found that, whatever the dry-bulb temperature, heat-regulation would begin to break down when the wet-bulb temperature rose above 88° F. (31.1° C.). Probably 70° F. (21.1° C.) should be regarded as the upper limit of safety in an operating theatre.

The hazards of hot and moist atmospheres have been emphasized, but those at the other extreme are scarcely less important. Cold surroundings will produce or aggravate surgical shock, and a very dry atmosphere will facilitate the production of high static electrical potentials, with a corresponding risk of explosion of inflammable vapours. Such dryness is but rarely encountered in Great Britain, but I have on at least one occasion heard the crackle of a static discharge in a theatre when a dry blanket was quickly pulled away from a trolley.

The formula ($P = S^w - f\Delta$) and the figures for partial pressures are taken from the Air Ministry Hygrometric Tables, M.O. 265 (1940), published by H.M. Stationery Office, and I have to thank the Director of Bidston Observatory for drawing my attention to that useful publication.

Summary

It is pointed out that an assessment of the drying capacity of the air can be made by a no more complicated procedure than finding the product of the sum and difference of the wet- and dry-bulb readings.

It is suggested that the atmosphere of operating theatres should be more rigorously investigated and controlled.

BIBLIOGRAPHY

- Beecher, H. K. (1938). *The Physiology of Anesthesia*, Chap. 4, Oxford University Press, London.
Haldane, J. S. (1905). *J. Hyg., Camb.*, 5, 494.
Smith, F. W. G. (1934). *British Medical Journal*, 1, 77.
Woolmer, R. F., et al. (1936). *Lancet*, 1, 1005.
Wright, A. D. (1933). *British Medical Journal*, 2, 1210.

TRAUMATIC URAEMIA: RECOVERY

BY

J. C. SCOTT, M.S., F.R.C.S.

AND

C. G. ROB, F.R.C.S.

(From the Radcliffe Infirmary, Oxford)

Below is reported a case in which a penetrating wound of the right thigh with division of the femoral artery and vein, without any apparent injury to the abdomen or left leg, led to an ischaemia of both legs. This was followed by a great increase of blood urea and other signs suggesting the onset of traumatic uraemia. After splanchnic block the blood urea fell and the general condition improved sufficiently to permit amputation of both legs. Following amputation progress was uninterrupted. Trueta and others (1946) suggest that splanchnic block should prove of value in

traumatic uraemia. The result in this case seems to give some support to that suggestion.

Case Report

The patient, an agricultural worker aged 65, was found lying in a pool of blood after his horse and cart had returned to the farm without him. As he was alone no details of the accident were available. It seems likely that the cart passed over his right leg.

He was admitted on July 5, 1946, about two hours after the injury, *in extremis*, with no ascertainable pulse or blood pressure. The only visible injury was a small puncture wound of the inner side of the right thigh. There was no bleeding from this wound on admission. X-ray examination showed no bone injury. The transfusion of 5 pints (2.8 l.) of plasma and 1 pint (0.57 l.) of blood (group B) raised the blood pressure to 110/60. No other immediate treatment was given.

On the morning after admission it was obvious that there was no circulation or sensation in the right leg below the knee. The left foot, in which the circulation had appeared satisfactory on the previous evening, now showed cyanosis of the toes. The popliteal pulse was palpable, but neither the posterior tibial nor the dorsalis pedis could be felt. There was no evidence of injury to this leg. The transfusion cannula had been inserted in the left ankle. Routine treatment for vascular injury was carried out—that is, heat to trunk, exposure of limbs, no smoking, 1 oz. (28 ml.) of brandy or whisky four-hourly. In view of impending gangrene of the right leg and the failing circulation of the left leg, exploration of the wound was considered advisable. This was carried out about 22 hours after the injury. There was considerable muscle damage, and the femoral artery and vein were completely divided at the junction of the middle and lower thirds and thrombosed. The wound was excised and closed with drainage after "icing" with proflavine-sulphathiazole powder. The following day the patient's general condition was poor. He was at times irrational and incontinent. The fluid intake was maintained—102 oz. (2.9 l.). The output was difficult to assess because of incontinence, but appeared to be lowered—20 oz. (0.6 l.). The blood pressure rose to 145/80. The general condition was about the same on July 8. The right leg was avascular to the knee, and the left avascular to the level of the ankle. The blood urea was 168 mg. per 100 ml.; plasma chloride, 525 mg. NaCl per 100 ml. (90 m-equiv./litre); plasma bicarbonate, 56 vols. per 100 ml. (25 m-equiv./litre); plasma protein, total, 5.42 g. per 100 ml. (albumin, 3.52 g.). The fluid intake was 84 oz. (2.4 l.) and the output 49 oz. (1.4 l.).

In view of these findings splanchnic block was advised, being carried out by Dr. MacKay of the department of anaesthetics: 40 ml. of 5% "novocain" was injected by the post route under 0.2 g. of thiopentone. After the injection the blood pressure dropped 20 points. Investigations on subsequent days were: July 9: blood urea 184 mg. per 100 ml. haemoglobin (?) (specimen taken soon after splanchnic block); July 10: 128 mg., 50%; July 11: 96 mg., 42%; July 13: 72 mg., 50%; July 15: 80 mg., 40%; July 19: 50 mg., 62%.

On July 18 the difficulty with regard to measuring fluid output persisted. The general condition of the patient remained about the same. There was general emaciation but otherwise no serious deterioration. Gangrene of both legs was well developed. The right leg was dry, requiring above-knee amputation. There were some blisters on the left leg and mild cellulitis. An above-knee amputation of the right leg was performed and 2 pints (1.1 l.) of blood was given. Next day the general condition improved, and he was rational for longer periods. The pulse was 110; blood pressure 130/80; haemoglobin 62%; blood urea 50 mg. per 100 ml. On the 24th the haemoglobin was 64% and the blood urea 28 mg. per 100 ml. A below-knee amputation of the left leg was made on the 25th and 2 pints (1.1 l.) of blood were given. On July 31 the haemoglobin was 84%.

Since the second amputation the progress has been uneventful. Incontinence has completely ceased, and the patient is rational; he eats and sleeps well, and the stumps are practically healed.

REFERENCE

Trueta, J., and others (1946). *Lancet*, 2, 237.

MASSIVE PENICILLIN DOSES IN GENERAL PRACTICE

BY

D. P. WHEATLEY, M.B., M.R.C.S.

In the *Journal* of Nov. 30, 1946 (p. 842), it was stated that the writer knew of no comparative data for larger doses of penicillin than 100,000 units, or of such doses at infrequent intervals. I venture, therefore, to record a few minor conditions treated by this method in general practice.

Case Reports

Case 1.—Mrs. S., aged 45, had been troubled for some time with recurrent and severe boils in the nose. The usual duration of one of these was one to two weeks. Two days before I saw her one had started, and she consulted me as she was particularly anxious to go away for a week-end two days later. She had a full-blown and very painful boil just inside her nose. I gave her 200,000 units of penicillin by intramuscular injection, this being repeated the following day. The next day the boil had almost completely subsided, and gave her no further trouble.

Case 2.—Mr. P., aged 32, had had a large whitlow on the third finger of his left hand for three days. It was already discharging, but the whole finger was grossly reddened and swollen. In addition, he felt unwell, and an eruption of small furuncles had broken out all over his body. He was given 200,000 units of penicillin. The next day he felt very well in himself, although there was no significant change in the whitlow. A further 200,000 units was administered, and the following day the whitlow was discharging profusely, most of the swelling had subsided, and the furuncles had almost disappeared. Two further injections of 200,000 units were given, and he was able to return to work one week after the beginning of the infection. He was seen a week later, when the finger was practically healed.

Case 3.—Mr. S., aged 42, had had a severe carbuncle just below his left elbow for three days; there was much inflammation, and several heads were beginning to form. He felt unwell, and had a slight temperature. He was given 200,000 units of penicillin. The next day he felt much better, his temperature had fallen, and the heads of the carbuncle had increased in size and were already discharging. A further dose was given, and the next day the lesion was discharging profusely, much of the inflammation had subsided, and the patient was later able to express the main core of the carbuncle. Two further injections were given, and a week later (ten days from its onset) the lesion had completely subsided. No local treatment was given.

Case 4.—Master P., aged 5, had had a purulent conjunctivitis, gradually getting worse over a period of one week. When seen his left eye was completely closed, much swollen, and a purulent exudate oozed from under the lids. He was given 50,000 units of penicillin. The next day he was able to open the eye and much of the swelling had gone down, although there was still a purulent discharge. Two further doses of 50,000 units were given on the following two days. The eye was then perfectly normal, except for one or two small tags of crusted exudate on the lashes.

Case 5.—Miss F., aged 12, had a large sty on the lower lid of her left eye. This had been treated with ung. hyd. oxid. flav., and had all but cleared up when it broke out again. There was a similar occurrence after penicillin ointment. In all, she had suffered from the sty for a period of two weeks. A single injection of 200,000 units of penicillin was given, but she declined a further injection, as she did not relish the procedure. As it happened, this was not necessary, for by the next day the condition had cleared up.

Case 6.—Mr. G., aged 52, developed a carbuncle on his neck, following an eruption of boils; he had never had either before. When first seen the carbuncle was of ten days' duration. He had several small healed boils, and another carbuncle, three days old, was forming on his right thigh, so far without a head. He was given four daily injections of 200,000 units each of the highly purified white crystalline penicillin. At the end of