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POTASSIUM LEVELS IN THE CEREBROSPINAL FLUID AFTER DEATH

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It is well known that diffusion from the red cells makes estimation of the serum potassium after death useless as a measure of its level during life. It was thought that in the cerebrospinal fluid, whose contact with blood is relatively slight, the level might rise slowly enough for its measurement to be of value. A single estimation was enough to show that this idea was false, and that potassium diffuses rapidly into the C.S.F. after death. No record of this phenomenon could be found in the literature, and some further study was thought to be indicated. The importance of potassium in nervous tissue (Cowan, 1934; Hodgkin and Huxley, 1947; Hoagland and Stone, 1948) and in the C.S.F. itself (Watchorn and McCance, 1933; Greenfield, 1936; Helmsworth, 1947) needs no emphasis. If the rate at which the potassium level rises proved regular enough, it seemed possible that the method might have some medico-legal importance as a means of estimating the time since death.

Methods

Fifty-eight samples of cisternal cerebrospinal fluid were obtained from 46 bodies, selected at random from those coming to the hospital mortuary, excluding those with meningeal disease or anything likely to disturb the serum potassium level. About 2 ml. of C.S.F. were removed on each occasion, using the ordinary technique of cisternal puncture with a lumbar puncture needle. Samples which were slightly contaminated with blood were centrifuged, and no further samples were taken from a case once contamination had occurred. A few samples with heavy blood contamination gave unduly low readings. Multiple estimations were done in eight cases (Table I), but no more than four in any case, since it was thought that removal of more than a few millilitres of fluid might unduly change conditions in the cisterna.

Potassium levels were determined with the flame photometer, using the method described by Domingo and Klyne (1949) for serum potassium.

Results

The results are presented in Fig. 1. If potassium concentration is plotted against the logarithm of time, a very fair approximation to a straight line is produced. Assuming a linear relationship, the regression line* is:

$$K = 48.56 + 61.45 \log_{10} t$$

* The regression may be taken for the present purpose as the line which best represents one variable in terms of the other, where one of them is more liable to error than the other. Its calculation involves the determination of the line for which the sum of the squares of the deviation of the individual values from the line is least (Fisher, 1946).

TABLE I

MULTIPLE ESTIMATIONS OF POTASSIUM LEVELS IN EIGHT CASES

Case No.	Time after Death (hrs. and mins.)	Potassium Level (mg./100 ml.)
3	8.15 55.15	146 174
5	3.15 4.15	76 80
6	8.30 10.30	100 108
8	1.30 5.45 24.45	56 100 146
34	2.30 6.30 8.0 25.0	66 81 117 136
40	3.0 6.15	52 88
44	9.0 14.45	113 121
48	3.45 5.45 7.30	80 105 144

where K is the C.S.F. potassium in mg./100 ml. and t is the time in hours since death. The slope of this line is highly significant ($P < 0.001$): the standard error of the deviations of the K values from the line is ± 19.4 mg.

The degree of scatter of the results is unfortunately such that the time since death cannot be estimated with any accuracy from the potassium level. Thus, for example, a reading of 100 mg./100 ml. might be obtained between four and 18 hours after death, or occasionally outside these limits. Under the more varied environmental conditions of medico-legal work it is likely that the scatter would be even greater.

Summary

The C.S.F. potassium level rises rapidly after death.

Fifty-eight samples were obtained from 46 bodies one and a half to 70 hours after death, and the potassium level estimated with the flame photometer. The concentration increases during this period in proportion to the logarithm of the time since death.

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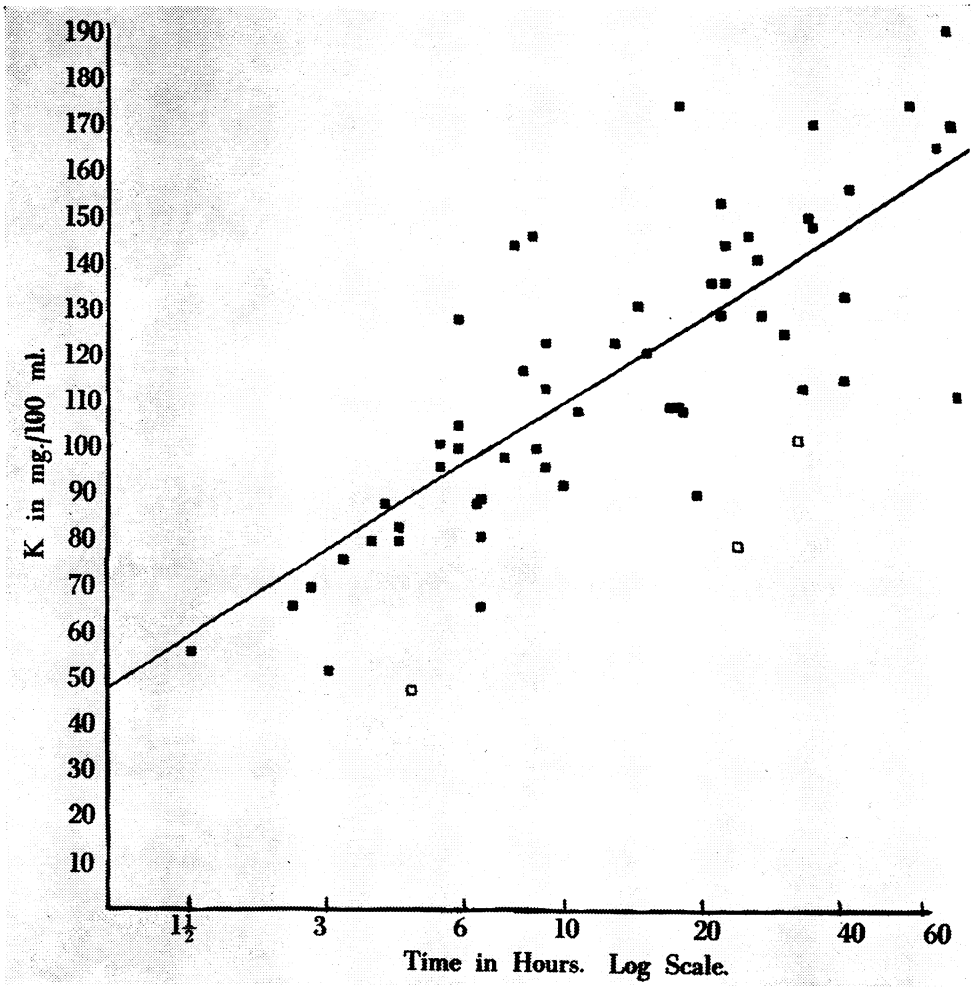

FIG. 1.—The potassium values are plotted against the log of the time (black squares). The open squares represent the values obtained with three specimens which were heavily contaminated with blood. The solid line is the regression line calculated by Dr. Mitchison.

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