

ONK-43

OFFICE OF NAVAL RESEARCH

CONTRACT N5-ori-76
T.O. 13

NAV1.941208.092

"A STUDY OF CELLULAR BIOCHEMISTRY IN SURGICAL PATIENTS"

OLIVER COPE

AND

FRANCIS D. MOORE

PROGRESS REPORT

First Quarter

1947

DEPARTMENT OF SURGERY

MASSACHUSETTS GENERAL HOSPITAL

HARVARD MEDICAL SCHOOL

BOSTON, MASS.

APRIL 30, 1947

OFFICE OF NAVAL RESEARCH

CONTRACT N6-ori-76
T.O. 13

Technical Report
on
METHODS AND PRELIMINARY FINDINGS

DEPARTMENT OF SURGERY
MASSACHUSETTS GENERAL HOSPITAL
HARVARD MEDICAL SCHOOL
BOSTON, MASS.

Technical Report No. 1

Edited by Oliver Cope, Director

April 30, 1947

ABSTRACT

The following report deals with those methods and preliminary results which have been obtained in a study of cell nutrition in surgical patients. Technical problems have related to the use of radioactive potassium (K^{42}) in the study of potassium metabolism, the correlation of experimental methods to be employed, the use of the falling drop apparatus for deuterium determinations, and the calculation of the total exchangeable body K.

Our initial findings may be summarized by stating that the patients, both well and ill, exhibit a remarkable constancy in their metabolism of a single tracer dose of K^{42} . The total body exchangeable potassium measured by dilution of K^{42} varies over a wide range and is as yet difficult to interpret relative to body weight. Other references for calculation are being studied. We find no striking "diuresis" of potassium after trauma, apart from that expected to follow the loss of nitrogen incident thereto. With rare exceptions we have not observed mass shifts of potassium independent of nitrogen, which might be interpreted as alteration of intracellular chemistry without loss of protoplasm. Studies on cell equilibrium with K^{42} indicate that there is a non-exchangeable fraction of potassium in red cells and that therefore this cell cannot be used for the calculation of total body potassium, but that after 40 hours the potassium in urine, muscle and plasma has reached equilibrium. Any of these activity ratios may therefore be used for the calculation of $\frac{K^{42}}{K^{39}}$ at equilibrium and hence of the total exchangeable K.

A simple bedside method of estimating urinary potassium by precipitation as the perchlorate has been developed and is being further studied.

REPORT PROPER

I. MATERIAL STUDIED

a. Twenty-three patients have been studied by injections of K^{42} , with subsequent measurement of the renal excretion of K^{39} and K^{42} . This simplest type of study has been termed the "Potassium Tolerance Test" and provides a measure of the state of potassium metabolism at the time of the injection.

b. Five patients have had studies of nitrogen, potassium, sodium and caloric balance carried out without isotope injection. This simple type of balance experiment was carried out wholly for the purpose of control and development of collection technic.

c. Injections of K^{42} coincident with balance studies have been carried out in sixteen patients. These patients have been both "normal controls" and seriously ill patients, including some who were so ill that they died during the period of observation. The combination of balance studies and isotope injections permit a more nearly complete depiction of potassium metabolism than either one alone.

d. In twenty-one patients, including some of those mentioned above, not only have complete balances been carried out with study of the metabolism of tracer doses of K^{42} , but in addition the specific activity ($\frac{K^{42}}{K^{39}}$) ratios have been determined in tissues and body fluids. The tissues have been obtained at operation and have consisted of muscle, both smooth muscle and striated muscle, liver, pancreas, bowel wall, stomach wall, and cancer tissue. The body fluids studied have been urine and plasma. Red cells have been extensively studied relative to exchange of K^{42} .

II. METHODS

1. Radioactivity Technics

a. Employment of K^{42} in human patients. Our work with K^{42} dates back to the early spring of 1946 at which time K^{42} was obtained from the cyclotron at Massachusetts Institute of Technology. This material was of relatively low specific activity due to the unfavorable "capture cross-section" of K as compared with Na. Commencing in October 1946 we have obtained K^{42} from the uranium pile at Oak Ridge, Tennessee.

The shipment and handling of this short-lived isotope have provided some interesting problems. The K^{42} is shipped to Boston by Air Express. Other workers who are employing short-lived isotopes (K^{42} has a half-life of 12.4 hours) should be aware of the fact that the Air Express service is not as yet wholly reliable for isotope transport. The shipments are occasionally lost in transit and occasionally removed from planes without any given reason.*

Upon arrival in Boston this material is processed by an isotope processing laboratory operating commercially. The target is obtained as a dry powder of K_2CO_3 and for this reason self-absorption is minimal. For that reason the isotope is at its most dangerous state when it is first obtained in the dry condition. At this time it contains a total activity of approximately 30 mc, 24 hours after removal from the pile. It should be handled only by special personnel using special instruments and observing special precautions. We have avoided unnecessary expense by having this done in a laboratory which was especially constructed for such purposes.** According to methods developed there under our direction, the K_2CO_3 is diluted in distilled water and brought to a pH of 7.0 by the addition of HCl.

*The total weight of the shipment plus container is approximately 140 pounds.

**Tracerlab, 55 Oliver Street, Boston, William Barbour, Director.

The solution is then a mixture of KCl and $KHCO_3$. The material is then diluted so that the potassium ion concentration is 120 mE/L and in this condition it is brought to our laboratories at the Massachusetts General Hospital. Here it is further diluted to a concentration of 60 mE/L, the pH is again checked and the material is autoclaved. It is then injected into adult human patients at a concentration of 60 mE/L, the total amount injected never exceeding 75 cc. The total activity injected varies between 0.05 and 0.5 mc. Safety precautions taken in our laboratory include the use of rubber and lead lined gloves, the wearing of badges by all personnel, storage of the concentrated isotope behind lead and the avoidance of personnel exposure to any of the high activity solutions.*

b. Detection and measurement. After injection of the radioactive material into the patient, samples of blood, urine, and tissue are taken at appropriate times. The experiments have been planned with relation to operative procedures so that tissue is obtained at periods which will be of significance. Urine is prepared for activity measurement by simple evaporation in a small ashing capsule. The beta radiation of K^{42} is of sufficient mean energy so that self-absorption effects are minimal if ordinary precautions are taken with body fluids. Plasma is difficult to measure accurately after several half-lives have elapsed because of the low potassium content of plasma. We have therefore seen fit to obtain fairly large amounts of plasma (5 to 15 cc. at each sample), precipitate the protein, and read the K^{42} on the protein-free filtrate. Red cell activities are measured by taking the cells with distilled water, precipitating the protein, and measuring the K^{42} on the protein-free filtrate.

* Early work with this Oak Ridge K^{42} showed that though pure Baker's Analyzed K_2CO_3 is used as the starting material, there was a relatively long-lived radio-contaminant present. Further investigation showed this to be precipitable with K as the perchlorate, and to have a half-life of approximately 21 days. It is surmised that this is rubidium⁸⁶, half-life 19.5 days. The removal of all traces of rubidium before exposure of target K_2CO_3 to neutrons is strongly urged.

Tissues are measured by dry ashing in a crucible over an open flame at a temperature of approximately 500°C. The ashed sample is then distributed evenly in a porcelain ashing capsule by the addition of a small amount of HCl. Control experiments have indicated the accuracy and reproducibility of these methods.

The physical equipment consists of a side wall beta ray counter attached to a scaling circuit.* The background of this apparatus ranges from 70 to 80 cpm. All of our samples are at least two to three times background and the great majority of them are approximately twenty times background.

2. Correlative Electrolyte Measurements.

a. K³⁹ analyses. Whenever a K⁴² determination has been carried out a concomitant determination of K³⁹ in the same tissue or body fluid has also been obtained. Without this data it is impossible to compute the specific activity ($\frac{K^{42}}{K^{39}}$) ratios and for that reason the determinations of K³⁹ are fully as important as the isotope data to the interpretation of results. The K³⁹ determinations have been made by the cobaltinitrite precipitation method of Fiske and Lilarczek.

b. Balances. Balance studies have been carried out by the customary technics involving quantitative collections of patients' urine and feces as well as quantitative measurements of all intake of food, parenteral fluid, etc. In addition, drainage from open wounds, or from gastrointestinal fistulae or tubes has been measured and analyzed. Operative blood loss is measured. Sodium determinations have been carried out by the uranyl zinc acetate method of Butler and Cuthill, and nitrogen by Kjeldahl determination.

* "Autoscaler"

3. Stable Isotope Technics.

a. Deuterium Measurement. The determination of total body water is an integral part of this program though still in technological development until recent weeks. The rationale for this technic has been previously described.* At the time our initial work was carried out, deuterium concentration was determined by means of the gradient tube. This method, however, was found to be variable and unreliable unless time-consuming precautions were taken. For this reason a shift to the falling drop method has been carried out.

The deuterium studies carried out to date under this contract have consisted largely of designing and erecting this new apparatus, and for that reason only a few measurements have been carried out in patients.

A constant-temperature bath was constructed which employed a mercury thermoregulator, electric heating, water cooling and high-power stirring. Initial experiments with this bath showed it to suffer from several faults, chiefly lack of sufficient depth, and vibration. The bath was therefore doubled in depth and the stirring motor attached to separate fixtures resulting in much more satisfactory operation of the bath. The overall temperature variation however still amounted to approximately $.01^{\circ}\text{C}$. This was too large to permit reproducible density readings and for that reason methods were sought to limit this temperature variation. The final method selected was the simplest, namely to build another small water bath within the outer bath. This amounts in essence to an inner water jacket for the falling drop tube, with a separate stirring motor all placed inside the large (40 gallon) bath. This installation produces a "buffering effect" on

*SCIENCE, Vol. 104, 157, 1946

the temperature variation of the outer bath and has been found to be extremely satisfactory. Using the "bath within a bath" method the o-fluorotoluene dropping tube can be held to temperature variations of less than .001°C for many hours at a time.

By these methods we have been able to obtain linear results with dilutions of deuterium in the range of .01 to 0.1 atom percent deuterium. This degree of accuracy will enable us to determine total body water of normal size adult patients by the use of approximately 250 cc. of 50 percent D₂O. Two experiments in patients have been carried out and yielded excellent checks, indicating that the method is now satisfactory for clinical use.

Expected release of deuterium from the Atomic Energy Commission may make this method even more practical. With larger amounts of D₂O available it may be possible to determine total body water with amounts of deuterium which will give final dilutions of approximately 1.0 atom percent. This weight of D₂O will permit accurate analyses with very simple apparatus and is a method which can be adapted to almost any laboratory. With the present lack of availability of D₂O, however, apparatus must be set up which is capable of fine discrimination in order to determine total body water.

III. RESULTS

a. Red cell potassium content. As a first approximation it was considered that the potassium content of the red cell might provide a rough barometer of intracellular potassium reserves in other body cells. Analyses of red cell potassium carried out on many patients in various states of health or illness have indicated however that there is remarkably little variation in potassium content. Potassium tends to move with the hemoglobin

rather than independently and we have obtained very little evidence that alterations in red cell potassium reflect in any way the intracellular chemistry of other body cells which differ from the red cells chiefly in the presence of the nucleus and a more heterogeneous protein system. Additional evidence relative to the rather peculiar state of potassium and protein in the red cell is described below.

b. Exchange data. After the injection of K^{42} studies of body fluids and tissues have permitted the construction of exchange curves showing the falling specific activity of K^{42} in the extracellular fluid - plasma, urine - and the rising specific activity of potassium in cells - red cell, muscle, liver. At approximately 40 hours a condition of equilibrium has been obtained. However it is of interest that the specific activity of the potassium in the red cells under these equilibrium conditions is not equal to that in urine, plasma or muscle. We find, in other words, that approximately one-fifth of the potassium in the red cell is not exchangeable with plasma potassium. One must conclude from this that a moiety of intracellular K in the red cell is "bound" or non-polar and not exchangeable.

The $\frac{K^{42}}{K^{39}}$ ratios (specific activity) of urine, plasma, muscle and other tissues show consistent equilibrium conditions at 40 hours. Prior to that time there are variations in the curves which are of some theoretical interest but which we are not as yet prepared to interpret in detail. It therefore follows that if one is measuring the total body exchangeable potassium by dilution of K^{42} the red cell is not a satisfactory cell in which to measure the final $\frac{K^{42}}{K^{39}}$ ratio. This is in contradiction to our previously reported findings. The total body potassium figures which result from muscle or urine specific activity calculations are considerably lower than those obtained when the red cell is used. Exchange curves and total body potassium figures are appended to this report.

c. Balance data. Negative nitrogen and potassium balances after surgical operations have previously been reported. Our purpose relative to these balance data may be described as falling under several headings, in addition to the important fact that they provide a background essential to the interpretation of the isotope data:

- 1.) Study of relation of N to K balance.
- 2.) Study of relation of Na to K balance.
- 3.) Study of reversal of the N-K negativity by therapy.
- 4.) Study of evidence of disproportionate K loss.

The findings under these various categories may be briefly summarized.

1. We find there is a constant relation between nitrogen and potassium loss in most of the patients observed. This is in contrast to data previously obtained in burned patients, and to be reported in the near future.

2. While potassium balance is negative, sodium balance is nearly always positive. This may be artefact resulting from the nature of present-day surgical therapy. While the patient is taking nothing by mouth he is frequently being given intravenous injections containing sodium. Were he in normal health and confined to bed on this regime the result would be a negative potassium and positive sodium balance. Therefore one cannot draw conclusions relative to Na-K shift across the cell membrane from these data alone. Further study in this area is necessary before drawing any conclusions.

3. Reversal of these changes by therapy is in its earliest stages in this study. We have preferred to observe patients as treated at present in this hospital before beginning therapy with potassium or other substances directed at cell nutrition.

4. A disproportionate loss of potassium in the early stages of illness following intestinal obstruction, peritonitis, burns, etc. has not been observed. By "disproportionate" is meant a loss of potassium over and above that to be predicted on the basis of the nitrogen loss. Again further study is necessary before final conclusions can be drawn.

d. Potassium tolerance test. These simple tests of the renal handling of a single tracer dose of K^{42} have been carried out in enough patients to indicate several trends. When the excretion of K^{42} is corrected for the excretion of K^{39} a remarkable constancy is obtained. This ratio ranges in the general vicinity of 0.5 to 1.0 percent of the administered dose of K^{42} per milliequivalent of potassium. This obtains over a wide range of activities and potassium dosages. It is found in patients who are extremely ill as well as in patients who are healthy. There are some minor departures from this trend in urinary excretion but in general they are small.

The total excretion of the isotope as expressed in percent of dose excreted per hour varies widely. A patient suffering from Cushing's disease excreted 12 percent of the injected dose in the first twelve hours, and showed a remarkably low total body potassium. Other patients who have been chronically ill and who might be thought of as demonstrating cellular starvation have tended to excrete very small amounts of the K^{42} (1 to 4 percent of the injected dose) in their first twelve hours. As noted above these isotope excretions are largely conditioned by the total excretion of potassium in the urine. We have therefore not found any indices of value from the renal handling of single tracer doses of K^{42} , that cannot equally well be determined by studying the K excretion in terms of milliequivalents per hour. However we have established "norms" by the combined study of K^{42} and K^{39} which will provide a reference point for future work. The normal

rate of K excretion is 1-3 milliequivalents per hour. Figures greater than this indicate excessive endogenous or exogenous K in body fluids. Figures less than this indicate an intake which is low in relation to the needs of the organism.

e. Qualitative urinary potassium determination. The rate of K excretion in the urine becomes of significance when considered together with the intake. A patient on a low-K (or no-K) diet (as with present intravenous regimes) ordinarily excretes small amounts of K in the urine. If a large K excretion is present, a tissue-destroying process is taking place; contrariwise a patient on normal K intake who excretes little or no K is building tissue.

Present K methods are so cumbersome that a simple bedside K analysis would be useful and we have found that precipitation of K as $KClO_4$ in an 80 percent alcoholic solution of urine provides a rough qualitative test which may be useful. If no precipitate is grossly visible the test indicates a K content lower than 15 mE/L. A heavy precipitate indicates that K is present in excess of 90 mE/L. Intermediate gradations may be read with rough qualitative significance.

IV. SUMMARY

a. This is a broad program which is still in progress; any extensive summary is impossible.

b. Studies on $\frac{K^{42}}{K^{39}}$ ratios indicate that there is a non-exchangeable fraction of potassium in the red cell; for this reason red cell specific activity cannot be used as "indicator" for calculation of total body exchangeable K.

c. Forty hours after the injection of K^{42} equilibrium has been obtained between muscle, plasma and urine.

d. Patients who are both well and ill demonstrate a remarkable constancy in the renal handling of K^{42} .

e. The rate of K^{39} excretion conditions the rate of K^{42} excretion to such an extent that the latter provides an important index of the state of K metabolism.

f. Overall studies of nitrogen, potassium and sodium balance are essential to an adequate interpretation of data resulting from the use of K^{42} .

g. Laboratory techniques for the measurement of deuterium concentration by the falling drop have been modified to suit the needs of our laboratory.

NS-ori-76 Task Order XIII
FIRST QUARTER REPORT - TABLE I

Explanation of Table

- Columns 1 & 2: Identity and disease of patient is described.
- Column 3: The state of the patient at the time of measurement is described. Many patients were systemically in normal health and are indicated as "well".
- Column 4: The tissue or body fluid from which "Equilibrium Specific Activity $\frac{K^{42}}{K^{39}}$ " is calculated.
- Column 5: Hours after injection at which these activities were observed.
- Column 6: Date of injection of K^{42} .
- Column 7: Total exchangeable potassium in milliequivalents (total K^{42} injected minus urine K^{42}).
equilibrium $\frac{K^{42}}{K^{39}}$
- Column 8: Body weight kilograms.
- Column 9: Total exchangeable K, milliequivalents per Kg.
- Column 10: Plasma volume by dye method.
- Column 11: Blood volume by dye method.
- Column 12: Date blood volumes were measured.
- Column 13: Total exchangeable K, milliequivalents per cc of plasma volume.
- Column 14: Total exchangeable K, milliequivalents per cc of blood volume.

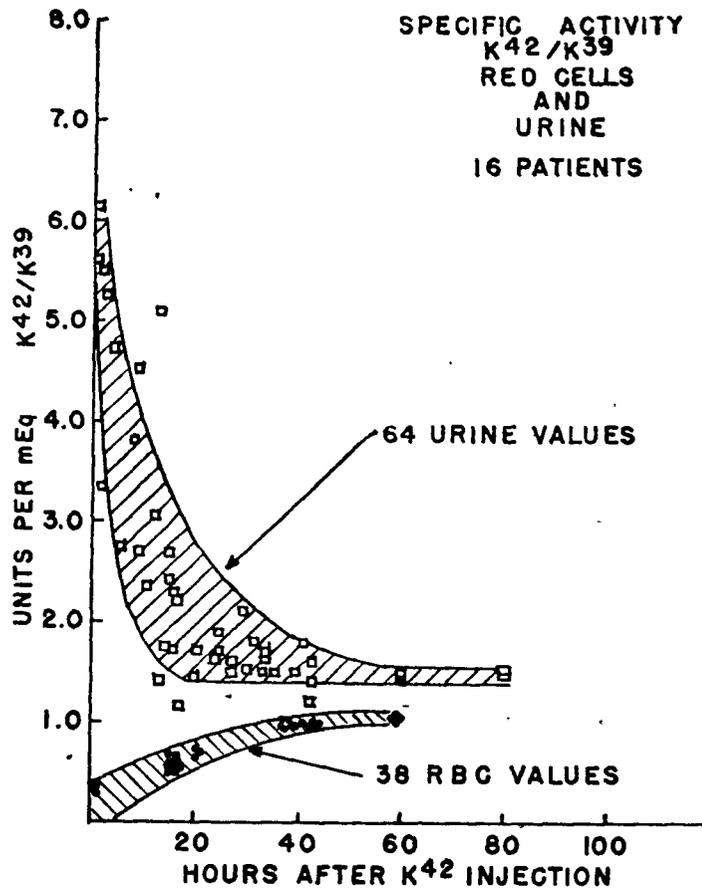


Figure 1

Specific activity of red cells and urine 0 to 80 hours after injection of K⁴². In this figure and the two subsequent figures the specific activity of the red cell potassium is used as a reference against which the specific activities of other fluids and tissues may be compared. The absolute activities per unit potassium vary over a wide range depending upon the original activity of the K⁴² and other factors. It is therefore essential to use a "reference value" so that the various experiments may be compared with each other. To do this the 40 hour specific activity of the red cell potassium has been arbitrarily designated as 1.0 "unit" of radioactivity per milliequivalent of potassium. All other values have then been adjusted accordingly.

In this chart 64 urine specific activities are contrasted with 38 red cell values on the same patients. The shaded area encloses 80% of the points for urine specific activity.

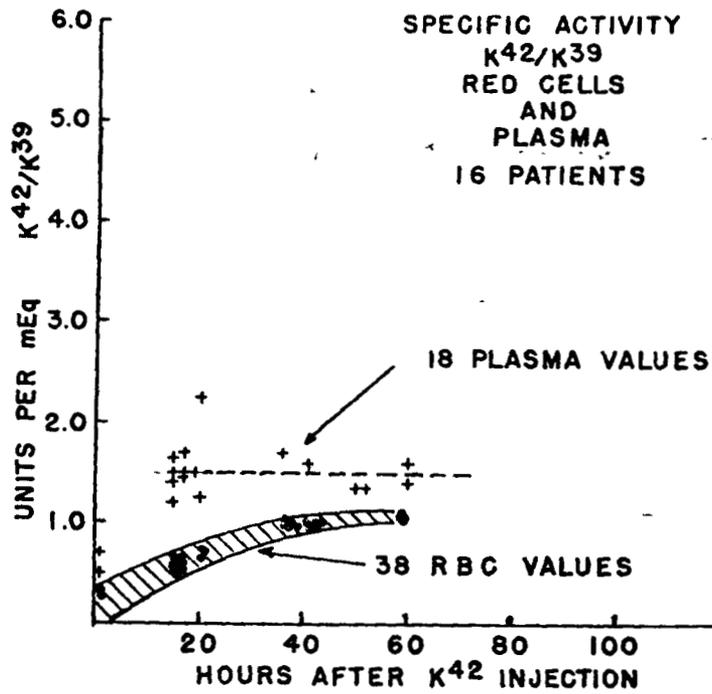


Figure 2

Specific activity of red cell and plasma potassium. This chart has been drawn up as described in Figure 1. The specific activity of plasma appears to reach and maintain a higher value than does the specific activity of potassium within the red cell, in a fashion similar to that portrayed for urine in Figure 1. Early plasma determinations between 0 and 20 hours are necessary before it is possible to interpret the early portion of this curve.

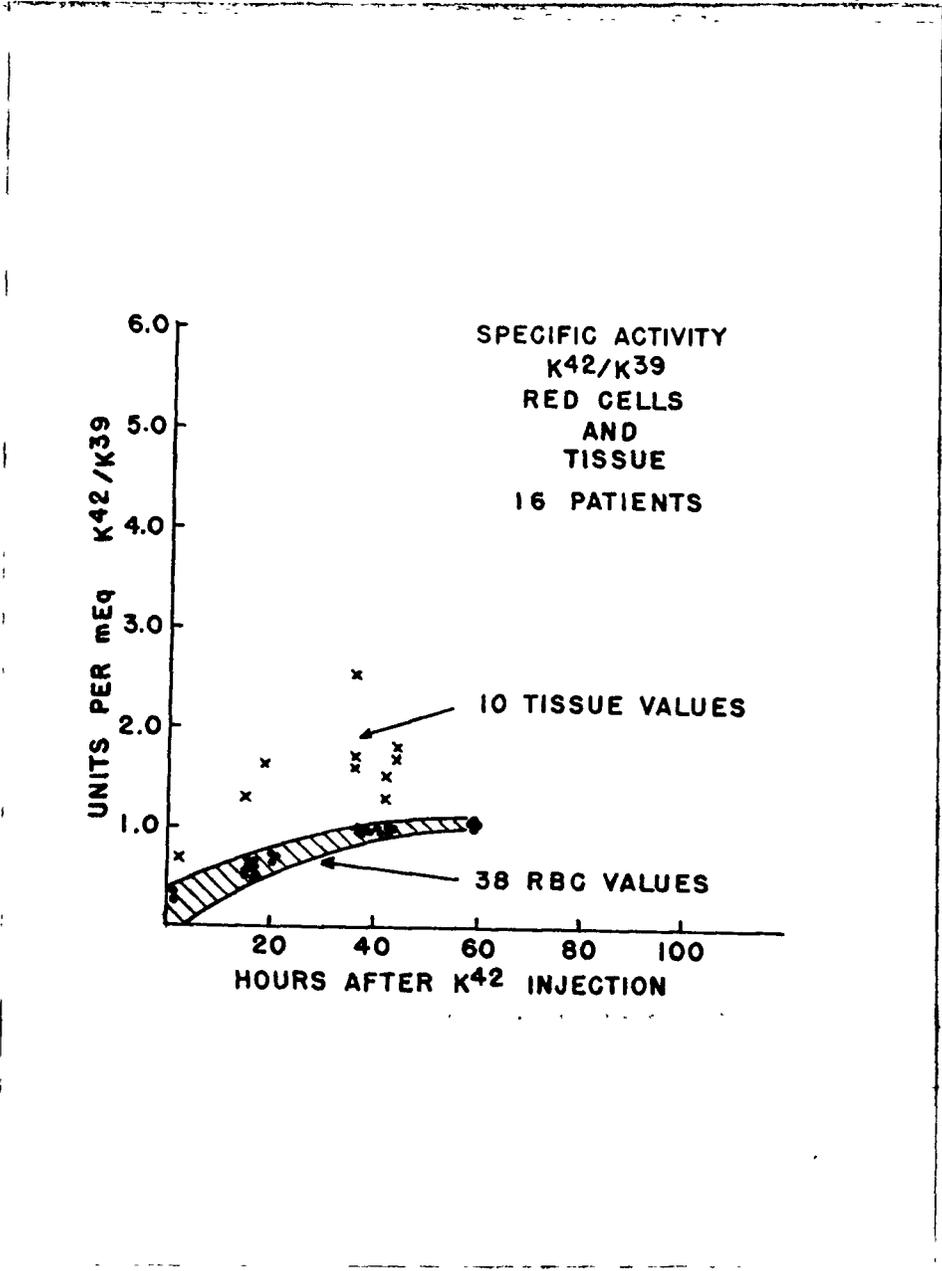


Figure 3

Specific activity of red cell and tissue potassium. This chart is prepared as Figures 1 and 2. Again the potassium in tissues appears to exchange with K⁴² to a greater extent than does the potassium within the red cell. The tissues shown in this chart are striated muscle with the exception of two points around 40 hours which are cancer tissue, and which do not show any striking deviation from the muscle determinations.

NJ - ori - 7c Bank Order XIII
FIRST QUARTER REPORT - TABLE I

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|-------------------------------|---------------------------|---|-----------------------|-------------------------|---------|---------------------|---------------|------------------------|----------------|-------------|----------------|----------------------------------|---------------------------------|
| Patient Age Sex VGH No. | Diagnosis | Clif. & State | Tissue or Fluid | Expts after Insec | Date | Total Exch K mEq | Body Wt Kg | Total Exch K mEq/Kg | Plus Vol cc | Blood cc | Date (Yols) | Total Exch mEq/cc Plus Vol | Exchable-K mEq/cc Blf Vol |
| AD 21 F 499922 | Cushing's Disease | 60 d post-op Pre-op 2nd op 15 d post-op | Urine | 24 | 4/29/46 | 2868 | 59.65 | 31.4 | | | | | |
| | | | Urine | 18-35 | 6/14/46 | 2575 | 65.18 | 39.5 | | | | | |
| | | | Urine | 34-40 | 6/27/46 | 1920 | 62.70 | 30.7 | | | | | |
| DOB 31 M 576033 | Cushing's Hypertension | Pre-op | Urine | 24 | 4/24/46 | 1070 | 82.40 | 12.4 | | | | | |
| EP 50 F 527743 | Chr Ulc Colitis | "Very ill" | Urine | 24 | 5/2/46 | 724 | 56.80 | 12.8 | | | | | |
| WS 56 M 297062 | Chr Ulc Colitis | Pre-op "Well" 12 d post-op | Urine | 24 | 5/2/46 | 1770 | 69.30 | 27.1 | | | | | |
| | | | Urine | 25 | 5/16/46 | 4580 | 52.30 | 70.3 | | | | | |
| IB 26 M 528422 | Infected Hand | "Well" | Urine | 24 | 5/2/46 | 1580 | | | | | | | |
| SS 57 M 525565 | Fibro- Sarcoma | Pre-op "Well" | Urine | 24-35 | 5/7/46 | 3590 | 68.20 | 52.6 | | | | | |
| MB 48 F 21315 | Subphrenic Abscess | 30 d post-op "Very ill" | Urine | 24 | 5/16/46 | 1560 | 64.00 | 24.4 | | | | | |
| HR 47 M 529663 | Gastric Ulc | 10 d post-op "Well" | Urine | 22-24 | 6/8/46 | 3850 | 66.00 | 58.3 | | | | | |
| AV 23 M 533467 | Appendi- citis | 6 d post-op "Well" | Urine | 24 | 6/3/46 | 4230 | | | | | | | |
| IB 38 F 527071 | Cushing's Disease | Pre-op | Urine | 30-42 | 6/14/46 | 1800 | 53.40 | 33.9 | | | | | |
| JB 63 F 218548 | Duod Ulc | 8 d post-op | Urine | 24 | 6/20/45 | 1730 | 59.80 | 30.0 | | | | | |

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|-----------------------------------|------------------------------|------------------------------|---------------------------|-------------------------|----------|------------------|---------------|---------------------|----------------|-----------------|----------------|---|------------------|
| Patient Age Sex I.D. No. | Diagnosis | Clinical State | Tissue or Fluid | Hours after Inlec | Date | Total Exch mg | Body wt kg | Total Exch mg/kg | Plas Vol cc | Blood Vol cc | Date (Yols) | Total Exchangeable mg/cc Plas Vol | mg/cc Bld Vol |
| SG 28 M 551209 | Jejunal Ulcer | Pre-op "Well" | Muscle | 41 | 12/17/46 | 3050 | 54.00 | 56.8 | | | | | |
| JK 17 M 554157 | Benign Tumour Leg | Pre-op "Well" | Muscle | 40 | 12/17/46 | 2150 | 75.20 | 15.4 | | | | | |
| JC 46 M 552535 | Hypertension | "Well" | Muscle | 40 | 12/27/46 | 1730 | | | | | | | |
| FB 67 M 554960 | Chronic Osteoarthritis | "Ill" | Urine Muscle | 38 40 | 2/15/47 | 2040 | 62.00 | 33.0 | | | | | |
| EC 38 M 316993 | Trigem Neuralgia | "Well" | Urine Muscle | 33 33 | 2/12/47 | 2040 | 56.05 | 36.4 | | | | | |
| AR 63 F 555058 | Cancer Breast | 30 d post-op "Well" | Plasma Urine | 41259 40861 | 1/24/47 | 1430 | 68.70 | 20.7 | | | | | |
| HR 26 F 496155 | Chronic PI Disease | Pre-op "Well" | Urine Muscle Plasma | 39860 18 15859 | 1/24/47 | 1470 | | | | | | | |
| LS 45 F 560038 | Cholelith Cholecyst | Pre-op "Well" | Urine Muscle Plasma | 36 37 15859 | 1/24/47 | 1660 | | | | | | | |
| MR 76 M 561043 | Cancer Rectum Prostate | Intest Obstr Pre-op "Ill" | Muscle Plasma Urine | 437 37 35960 | 1/24/47 | 1680 | 67.90 | 24.2 | | | | | |
| JD 35 M 559544 | Dood Ulc | Pre-op "Well" | Urine Plasma Muscle | 1233 18 19 | 2/7/47 | 2940 | 70.80 | 41.6 | 2990 | 4610 | 2/5/47 | 1.13 | 0.637 |
| SS 55 F 561643 | Acute Em Pancreatitis | "Very Ill" | Urine | 33 | 2/11/47 | 1040 | | | 2300 | 3830 | 2/5/47 | 0.454 | 0.273 |

