Evaluation of Myocardial Blood Perfusion in Man with Radioactive Potassium or Rubidium and Precordial Counting

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The purposes of this paper are (1) to describe the theoretical foundations and the technic for the measurement of the myocardial clearance of potassium by means of precordial counting and single intravenous injection of K⁴²Cl or Rb⁸⁶Cl; (2) to report the results obtained in subjects with normal cardiovascular systems and in subjects with coronary insufficiency in whom the myocardial clearance of potassium was measured under basal conditions and after nitroglycerin; and (3) to discuss the relationship between the measured clearance and the myocardial blood flow.

Theoretical Foundations

Myocardial Uptake of Circulating Indicators

The amount of a circulating indicator in the myocardium can be related to myocardial blood flow as:

\[ M_m(t) = Q_m \left( \int_0^t a(t) \, dt - \int_0^t v(t) \, dt \right) \]

where \( M \) is the myocardial mass, \( Q_m \) the capillary blood flow, \( a(t) \), \( v(t) \), and \( m(t) \) the indicator concentrations in arterial blood, venous blood, and myocardium, respectively.

Solving for specific flow to the myocardium one obtains

\[ Q_m = \frac{m(t)}{\bar{E} \int_0^t a(t) \, dt} \]

where

\[ \bar{E} = \frac{\int_0^t a(t) \, dt - \int_0^t v(t) \, dt}{\int_0^t a(t) \, dt} \]

is the integrated arteriovenous extraction ratio.

Equation 2 represents the foundation of the indirect Fick method, and it may be rearranged to express the myocardial clearance of a potassium indicator, MCK:

\[ MCK = \frac{Q_m}{M} \bar{E}_K = \frac{m(t)}{\bar{E} \int_0^t a(t) \, dt} \]

where \( \bar{E}_K \) is the integrated arteriovenous extraction ratio for the potassium indicator.

Previous findings in rats¹,² and dogs²,³ have shown that, if K⁴²Cl or Rb⁸⁶Cl is given intravenously as a single injection, the organ content of the indicator remains essentially unchanged for an appreciable time interval following the first circulation.

On the assumption that in man the amount of indicator in the myocardium remains constant during a certain time interval after the first circulation, the myocardial concentration at a time \( \tau \) during that interval and the integral of the primary arterial concentration curve \( A_1 \) can be introduced at the second member of equation 4, thus giving:

\[ MCK = \frac{m(\tau)}{A_1} \]

Measurement of the Myocardial Clearance of Potassium by Means of Precordial Counting

The precordial counting rate \( R_B \) due to a nondiffusible indicator like radioiodinated human serum albumin (RIHSA) is related to the radioactive concentration in blood \( \bar{c}_R \) as

\[ R_B = \bar{c}_R W_B \]
W H is the “effective volume,” i.e., the product of the activity-containing volume contributing precordial counts times the average counting efficiency for it, and it can be obtained dividing the precordial counting rate into the radioactive concentration in blood simultaneously measured.

On the other hand, after intravenous injection of Rb86Cl or K42Cl the precordial activity R E is made up of an intravascular (R H) and an extravascular (R E) component:

\[ R_E = R_H + R_E \] (7)

R H can be calculated using equation 6 if the radioactive concentration in blood is measured, W B is known from measurements carried out with the same geometry after injection of RIHS, and an \( \eta \) factor is introduced to account for the differences in energy of the two isotopes.5

R E may then be obtained subtracting R H from R E: it is made up of myocardial activity (R M) and activity in tissues other than myocardium. For a collimated counter, simple geometrical considerations suggest that the latter component is essentially represented by the striated muscles of the anterior chest wall.

Myocardial and chest wall components cannot be separated: their relative importance, in a given geometrical arrangement, depends on the relative radioactive concentration in the two tissues, which in turn depend on their relative perfusion rate, the mode of administration of the potassium indicator, and the time elapsed after its administration.

In case of single injection, the initial distribution of the potassium indicator is essentially proportional to the perfusion rates, so that activity in the slowly exchanging muscles of the anterior chest wall is small in comparison with activity in the myocardium, which has a perfusion rate 15 to 30 times greater. In fact, 2 minutes after a single injection of Rb86Cl in dogs, radioactive concentration in pectoral muscles is about 1/100 of the myocardial concentration, and after 30 minutes of Rb86Cl infusion myocardial activity still accounts for 70 per cent of the precordial counts.7

Thus, provided adequate shielding and gamma-discrimination eliminate radiations originating from the rest of the body, and the precordial counts are measured shortly after the first circulation of the indicator, R m may be assumed to be essentially equal to R E and may be derived from equations 6 and 7 as:

\[ R_m(\tau) = R_k(\tau) - \eta W H \bar{c}_k(\tau) \] (8)

where \( \bar{c}_k \) is the indicator concentration in blood and R m(\( \tau \)) indicates the myocardial contribution to the precordial counting rate, at a time \( \tau \) after completion of the first circulation of the indicator. R m(\( \tau \)) is related to the radioactive concentration in the myocardium \( \bar{m}(\tau) \) as:

\[ R_m(\tau) = \bar{m}(\tau) W_m \] (9)

where W m is the “effective volume” of myocardium contributing to the precordial counting rate.

On the other hand, the precordial curve recorded during the first passage of the indicator through the heart chambers is related to the primary arterial concentration curve:

\[ \int_0^\infty R_k(t) \, dt = W_H A_1 \] (10)

where W H is the “effective volume” of the heart chambers contributing to the first passage curve.4

Combining equations 5, 9, and 10 we get:

\[ \frac{MCK}{W_m} = \frac{W_H}{W_m} \int_0^\infty \frac{R_m(\tau)}{R_k(t)} \, dt \] (11)

which gives the initial myocardium clearance of potassium in terms that can be derived from precordial counting, and with an uncertainty given by the ratio W H/W m. The inverse square law which relates crystal to target distance, and the uneven arrangement of myocardial fibers around the chambers, make W m necessarily different from W H. With a detector in a position relatively remote from the chest wall, however, this difference may
be contained within very small limits.* If this difference is neglected, equation 11 reduces to:

$$MCK = \frac{R_m(\tau)}{\int_0^\infty R_K(t) \, dt} \quad (12)$$

which permits the calculation of MCK from the precordial record after single injection of a potassium indicator, with the only requirement of separating the myocardial component of the precordial counting rate.9

**Methods**

**Instruments and Operating Conditions**

The instruments used for precordial counting comprise a 2" x 2" NaI(T1) scintillation counter (Nuclear-Chicago DS-5) with lead collimating channel 75 mm. long (internal diameter 50 mm., external diameter 75 mm.). Pulses from the photomultiplier are fed, via a pulse height discriminator, to a scaler and a counting ratemeter connected in parallel. The output of the latter is recorded by means of a photographic multichannel recorder on which electrocardiographic and pressure tracings can be simultaneously recorded.

When $^{131}I$ activity is to be measured, the bias voltage is adjusted just below that corresponding to the 0.360 Mev. $\gamma$-photopeak. When Rb$^{86}$ or K$^{42}$ is measured, the bias voltage is adjusted to reject pulses of energy smaller than those corresponding to the 1.08 Mev. $\gamma$-photopeak for Rb$^{86}$, the 1.53 Mev. $\gamma$-photopeak for K$^{42}$.

The ratemeter time constant is set at 10 seconds for recording background prior to the injection of the indicators, at 1 second during inscription of the curves.

Blood activity is measured in a well-type scintillation counter, with the bias voltages adjusted according to the same criteria described for external counting of $^{131}I$, Rb$^{86}$ or K$^{42}$.

All the data obtained externally are corrected for the relative efficiencies in the "in vivo" and "in vitro" systems, introducing a coefficient $\bar{\eta}$ calculated from the counting rates obtained when two 500-ml. flasks containing known concentrations of $^{131}I$ and Rb$^{86}$ (or K$^{42}$) are exposed to the external counter under a standard geometrical arrangement:

$$\bar{\eta} = \frac{J^{131}}{J^{RB}} \cdot \frac{R_{RB}}{R^{RB}} \cdot \frac{W_B}{W} \cdot \frac{C_{PB}}{C_{PB}} \cdot \frac{\lambda_{RB}}{\lambda_{RB}}$$

**Experimental Procedure**

The experiments were performed in the morning, on fasting, resting subjects in the supine position.

After the introduction of a Cournand cannula into the left brachial artery, the counter was positioned over center of the heart silhouette, previously outlined under fluoroscopy.

Ten to 15 $\mu$c. of $^{131}I$ as RIHSA, in 0.5 to 1 ml. of saline were then rapidly injected into the right cubital vein. Thirty seconds after the injection the precordial counting and arterial blood sampling were started; both counting and blood sampling lasted 1 minute, with the rate of withdrawal adjusted by a metronome (1 ml. every 4 seconds).

From 2 to 3 minutes later, the recording ratemeter was turned on, and about 150 $\mu$c. of Rb$^{86}$ as rubidium chloride (or 75 $\mu$c. of K$^{42}$ as potassium chloride) in 0.5 to 1 ml. of saline were rapidly injected into a cubital vein as done for RIHSA. Precordial counts and arterial blood were taken exactly as previously done after RIHSA injection. Recording was continued until blood sampling and precordial counting were completed.

When a second measurement was to be carried out, care was taken to maintain the counter in the same position. After the precordial activity had been monitored and an arterial blood sample taken, a second injection of Rb$^{86}$ (or K$^{42}$) was given, with the above procedure (curve recording, precordial counting, and arterial sampling) repeated.

All the blood samples were hemolyzed and counted in duplicate.

The $\bar{\eta}$ coefficient was periodically measured to check the constancy of the conditions of the counting apparatus.

**Calculations**

The myocardial clearance (MCK for K$^{42}$, MCR for Rb$^{86}$) was calculated in two steps:

1. Calculation of the fraction $F$ of the precordial counting rate due to myocardial activity:

$$F = \frac{B_K - \bar{\eta} \cdot W_B \cdot \bar{a}_K}{R_K} \quad (14)$$

where

$$W_B = \frac{R_{RIHSA}}{\bar{a}_{RIHSA}}$$

and:

- $B_{RIHSA}$ and $B_K$: net number of counts collected on the scaler from 30 to 90 seconds after the

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* Model studies have shown that the difference should never exceed 5 per cent, $W_B$ being greater than $W_m$.  

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injection of RIHSA and potassium indicator, respectively; $a_{RIHSA}$ and $a_K$: radioactive concentrations per milliliter of arterial blood sampled from 30 to 90 seconds after the injection of RIHSA and potassium indicator, respectively; $\eta$: the relative counting efficiency defined in equation 13.

(2) Calculation of MCK(R) from the precordial trace (fig. 1):

$$MCK(R) = \frac{D_f \times F \times 60}{\int_0^\infty R_K(t) \, dt} \times 100 \ (15)$$

where:

$(D_f \times F) = R_m (\tau)$ of equation 12, and $D_f$: average net deflection (mm.) of the ratemeter trace in the minute during which precordial counts and arterial blood were taken

$$\int_0^\infty R_K(t) \, dt = \text{total area (mm. } \times \text{ seconds)}$$

under the radiocardiographic curve, completed by semilogarithmic extrapolation of the final downslope 60: time conversion factor from seconds to minutes.

MCK(R) calculated according to equation 15 was dimensionally a rate constant per minute (1 per minute); equating volume to mass units, it could be expressed as ml. per minute per 100 Gm. of myocardium.

When a second Rb$^{86}$Cl or K$^{42}$Cl injection was performed, the values of $R_K$ and $a_K$ introduced in equation 14 were obtained by subtracting from the precordial and blood counting rates obtained after the second equation the corresponding ones measured immediately prior to it.

Subjects and Experiments Performed

Seventy-one subjects were studied: 28 were young subjects with normal cardiovascular systems, and 43 had an established diagnosis of ischemic heart disease based on clinical and electrocardiographic data. Seventeen of them had arterial hypertension and were classified as hypertensive heart disease, while the remaining 26 were classified as coronary heart disease. In 10 cases of the latter group there was a history of angina.

In 68 cases the relative myocardial uptake of potassium (F) was measured according to the described procedure: radioactive potassium (K$^{42}$) was used in 29 cases, radioactive rubidium (Rb$^{86}$) in the remaining 39 cases. The myocardial clearance of Rb$^{86}$ and K$^{42}$ was calculated in 46 subjects (25 of whom were normal). In two cases, a second measurement under the same conditions was carried out. In 21 cases (4 normal subjects and 17 patients) the measurement was repeated 7 to 8 minutes after sublingual nitroglycerin (0.4 mg.).

In three additional normal subjects the experiment was performed with Rb$^{86}$Cl according to the same general protocol, with the only difference that the arterial sampling and precordial counting period was split in two parts, between 30 and 60 seconds, and between 60 and 90 seconds. All the calculations were then carried out as above for the two separate time intervals.

Radiation Dosimetry

The patients who had two Rb$^{86}$ injections of 150 $\mu$C, following 35 $\mu$C. of I$^{131}$ as RIHSA received an integral dose of the order of 2.0 rad. This was reduced to 0.30 rad. when K$^{42}$ was used instead of Rb$^{86}$.

Results

Myocardial Uptake of Rb$^{86}$ and K$^{42}$

The values of the myocardial fraction of the precordial counting rate (F) are reported in figure 2. The average F value is $66.6 \pm 6.72$ per cent in 10 normal subjects studied with K$^{42}$, $66.96 \pm 5.5$ per cent in 15 normal subjects studied with Rb$^{86}$. Results obtained with K$^{42}$ or Rb$^{86}$ have been combined in all the subsequent calculations. The combined average F value in the 25 subjects with normal

![Figure 1](http://circ.ahajournals.org/)

**Figure 1**

Calculation of myocardial clearance of potassium from the precordial tracing (see text). The area under the radiocardiographic curve is calculated after semilogarithmic extrapolation of the final downslope. $D_f$: the average deflection above background from 30 to 90 seconds after injection.
Myocardial blood perfusion

Cardiovascular systems is then 66.8 ± 6.1 per cent, significantly different from the average F value of 57.76 ± 17.2 per cent obtained in 17 patients with hypertensive heart disease (p < 0.05), and from that of 54.59 ± 13.0 per cent obtained in 26 cases of coronary heart disease (p < 0.01).

In the two cases in which a second measurement was done in the same conditions, the second F value deviated from the first one less than 5 per cent in one case, less than 1 per cent in the other.

The results of the three experiments in which the precordial counts and the arterial blood were separately collected in the two half minutes are reported in table 1. The arterial concentration and the vascular component of the precordial counting rate in the second half minute averaged 59 per cent and 51 per cent of their respective values in the first half minute, while the reduction of myocardial activity was 5 per cent only.

**Myocardial Clearance of Potassium**

MCK(R) values are reported in figure 3. In 25 subjects with normal cardiovascular systems MCK(R) averaged 87.93 ± 22.5 ml. per minute per 100 Gm. of myocardium; in 10 cases with hypertensive heart disease the mean clearance value is 69.06 ± 18.8 ml. per minute per 100 Gm., while in 11 cases with coronary heart disease the mean value is 62.54 ± 25.3 ml. per minute per 100 Gm. The average values of both groups differ significantly from the normal mean (p < 0.05 for the group with hypertensive heart disease HHD, p < 0.01 for the group with coronary heart disease).

**Effect of Nitroglycerin**

As shown in figure 4, in all subjects with normal cardiovascular systems an increment of MCK(R) was observed after administration of nitroglycerin, ranging from 5.4 to 58.4

**Table 1**

Variations of Radioactive Myocardial Content and Blood Activity from the Second to the Third Half Minute after Injection of Rb

<table>
<thead>
<tr>
<th>Case</th>
<th>Time (sec.)</th>
<th>F</th>
<th>Rk</th>
<th>Rm</th>
<th>Rk − Rm</th>
<th>5k</th>
</tr>
</thead>
<tbody>
<tr>
<td>B.P.</td>
<td>30 – 60</td>
<td>0.83</td>
<td>2542</td>
<td>2122</td>
<td></td>
<td>300</td>
</tr>
<tr>
<td></td>
<td>60 – 90</td>
<td>0.89</td>
<td>2245</td>
<td>1990</td>
<td></td>
<td>213</td>
</tr>
<tr>
<td></td>
<td>Diff.</td>
<td>+0.06</td>
<td>−12%</td>
<td>−6%</td>
<td>−39%</td>
<td>−29%</td>
</tr>
<tr>
<td>M.R.</td>
<td>30 – 60</td>
<td>0.81</td>
<td>2315</td>
<td>1887</td>
<td></td>
<td>264</td>
</tr>
<tr>
<td></td>
<td>60 – 90</td>
<td>0.88</td>
<td>2024</td>
<td>1791</td>
<td></td>
<td>163</td>
</tr>
<tr>
<td></td>
<td>Diff.</td>
<td>+0.07</td>
<td>−13%</td>
<td>−5%</td>
<td>−46%</td>
<td>−38%</td>
</tr>
<tr>
<td>B.E.</td>
<td>30 – 60</td>
<td>0.85</td>
<td>2288</td>
<td>1937</td>
<td></td>
<td>233</td>
</tr>
<tr>
<td></td>
<td>60 – 90</td>
<td>0.93</td>
<td>1998</td>
<td>1868</td>
<td></td>
<td>104</td>
</tr>
<tr>
<td></td>
<td>Diff.</td>
<td>+0.08</td>
<td>−13%</td>
<td>−4%</td>
<td>−63%</td>
<td>−55%</td>
</tr>
<tr>
<td></td>
<td>Avg. diff.</td>
<td>+0.07</td>
<td>−12.7%</td>
<td>−5%</td>
<td>−49.3%</td>
<td>−41%</td>
</tr>
</tbody>
</table>
ml. per minute per 100 Gm. of myocardium, with an average increase of +25.2 ml. per minute per 100 Gm., which was found to be statistically significant \( (p < 0.05) \).

In 9 of 10 nonhypertensive cases with coronary heart disease, \( \text{MCK}(R) \) decreased after nitroglycerin, the drop ranging from 1.1 to 47.5 ml. per minute per 100 Gm. of myocardium. In one case an increase of 3.7 ml. per minute per 100 Gm. was observed. The average change in the group amounted to \(-14.7\) ml. per minute per 100 Gm., which was found to be statistically significant \( (p < 0.01) \).

In the hypertensive group the administration of nitroglycerin was followed by an increase of the clearance values in three cases (ranging from 3.8 to 11.4 ml. per minute per 100 Gm.), by a reduction (ranging from \(-5.2\) to \(-21.0\) ml. per minute per 100 Gm.) in the remaining four cases. The average change in the whole group amounted to \(-4.9\) ml. per minute per 100 Gm., and it was not found statistically significant \( (p < 0.4) \).

**Discussion**

The lack of systematic differences between \( \text{K}^{42}\text{Cl} \) and \( \text{Rb}^{86}\text{Cl} \) clearance confirms previous observations that the two ions are handled in a similar fashion by the myocardium.\(^6\)

In recent years, various attempts have been made\(^10,11\) to obtain information concerning myocardial blood perfusion in man, from the rate of increase of precordial radioactivity during a continuous infusion of \( \text{Rb}^{86}\text{Cl} \). These investigations, however, have encountered various difficulties that have prevented their development into practicable technics;\(^9,12\) during the period of infusion, the myocardium and the striated muscles of the anterior chest wall take up and release radioactivity at sub-

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**Figure 3**

Myocardial clearance of radioactive potassium and rubidium (combined) in normal subjects, in cases of hypertensive heart disease (HHD) and coronary heart disease (CHD). The horizontal line indicates the average value of each group.
MYOCARDIAL BLOOD PERFUSION

stantially different rates, so that separation of myocardial from other tissue components in the precordial activity curve becomes a major problem.

On the other hand, evidence collected in various animals has shown that the initial partition of a single bolus of K\textsuperscript{42} or Rb\textsuperscript{86} is proportional to the distribution of cardiac output, and that this distribution is maintained for a certain time after completion of the first circulation.\textsuperscript{1-3}

On these grounds, one would expect that the study of the myocardial uptake of a potassium indicator immediately after a single injection would prove a simpler approach to the problem of estimating myocardial blood perfusion.\textsuperscript{9}

The results reported in this paper seem to support this expectancy.

The small changes in myocardial activity observed from the 30 to 60-second to the 60 to 90-second period, despite the marked changes in blood activity, agree perfectly with the results of the animal studies.

Moreover, the MCK(R) values observed in the normal group agree surprisingly well with the values for coronary blood flow usually obtained with the method of Kety,\textsuperscript{13, 14} in the same way as the uptake of Rb\textsuperscript{86} or K\textsuperscript{42} by the heart of dogs and rats compares very closely with the fraction of cardiac output perfusing their myocardium.\textsuperscript{1, 2}

A myocardial extraction ratio of 1.00 would readily explain all these findings, but such an interpretation is obviously untenable, since both K\textsuperscript{42} and Rb\textsuperscript{86} are known to recirculate in considerable amounts. The only other possible explanation is that proposed by Sapirstein,\textsuperscript{2} i.e., that myocardial extraction ratio does not differ significantly from whole-body extraction ratio.

From equation 1 the myocardial concentration \( m(\tau) \) at a time \( \tau \) after the completion of the first circulation can be written as

\[
m(\tau) = \frac{Q_m}{M} \left( \int_0^\tau a(t) \, dt - \int_0^\tau v_m(t) \, dt \right) (16)
\]

If we indicate with \( a_r(t) \) the arterial concentration due to recirculating activity only, we may write:

\[
\int_0^\tau a(t) \, dt = A_1 + \int_0^\tau a_r(t) \, dt (17)
\]

Since the loss of potassium indicator in the pulmonary circulation is known to be negligible, the integral of the recirculating arterial concentration may be equated to the integral of the mixed venous concentration \( \bar{v}(t) \):

\[
\int_0^\tau a_r(t) \, dt = \int_0^\tau \bar{v}(t) \, dt (18)
\]

If the integral of the coronary venous concentration does not differ significantly from the integral of the mixed venous concentration, combining equations 16 through 18 and solving for specific flow, one obtains

\[
Q_m = \frac{M(\tau)}{A_1} (19)
\]

which is the same as equation 5 for MCK(R). If this is the case, as the data from studies on animals and the present results would suggest, MCK(R) reflects myocardial blood flow not because the instantaneous myocardial extraction ratio equals 1.00, but because the integrated myocardial arteriovenous difference from time \( O \) to time \( \tau \) equals the integral of the primary arterial circulation.

As Sapirstein points out\textsuperscript{2} this behavior could be explained by a ratio of myocardial perfusion rate to the size of myocardial potassium compartment equal to the ratio of the cardiac output to the body exchangeable potassium.

The validity of this interpretation cannot be proved on the basis of the present data, since no attempt was made to obtain coronary venous blood. No other explanation, however, at present accounts for both the slight change of myocardial radioactive content in the presence of appreciable recirculation and the agreement of the clearance values with the accepted data for coronary blood flow. Supporting evidence for this theory has been ob-
tained in animals and has been extensively discussed by Sapirstein.2

Discussion of the results of the studies with patients and of the nitroglycerin experiments is beyond the purposes of this paper; it is worth pointing out, however, that the distribution of the clearance values fits well with the expectancy on the basis of clinical and electrocardiographic data, and that the results of the nitroglycerin studies are in complete agreement with those reported by Gorlin et al.15 using the inert gas method.

In the first section of this paper it was shown that the MCK(R) equation is similar to the indirect Fick equation, the main difference being that in the Kety method myocardial concentration is estimated from the coronary sinus blood, whereas in the present method the myocardial concentration is derived from the precordial counting rate. This implies that, while sections of myocardium not perfused or not drained via the coronary sinus do not contribute to the flow value obtained with Kety’s method, every single volume unit of myocardium, no matter how perfused or drained, contributes to the MCK value, although in variable proportions according to the over-all counting efficiency for it.

Various developments can be foreseen in order to overcome the limitation due to the unequal counting efficiency for different sections of myocardium, including the use of rubidium-84 and coincidence counting, as proposed by Bennish and Bing.16 If independence from geometry could be attained, it would then become possible to express MCK in absolute terms instead of referring it to the unit mass of myocardium.

Finally, it seems relevant to stress that the method presented in this paper is relatively simple and of little trouble to the patient, so that its use may prove of interest in the clinical evaluation of myocardial blood perfusion.

Summary

The myocardial clearance of potassium may be obtained by precordial counting after a single intravenous injection of K42Cl or Rb86Cl. The theoretical foundations of the method and the technic developed have been presented and discussed.

The distribution of the values obtained in normal subjects and in subjects with coronary insufficiency is in agreement with the clinical expectancy, and changes of the observed MCK after nitroglycerin agree with the results obtained by other investigators who measured coronary blood flow by the indirect Fick method.

In agreement with the observations of other investigators in rats and dogs, the amount of K42 or Rb86 in the myocardium was found to change very little for an appreciable time interval after the first circulation, despite the significant recirculation and the decreasing arterial concentration. This observation and the fact that MCK values in normal subjects closely agree with the accepted values for coronary blood flow confirm Sapirstein’s findings in rats and dogs, and support the view that the organ uptake of Rb86 or K42 immediately after single intravenous injection reflects the fractional organ blood flow.

As obtained with the present technic, and similarly with the indirect Fick method, MCK reflects the flow per gram of myocardium and not the total coronary blood flow. MCK, however, has the advantage that every unit volume of myocardium, no matter how well it is perfused or through which vessels it is drained, contributes to the precordial counting rate in variable proportions determined by the efficiency of the counting method.

References


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Observation and Experiment in the Medical Sciences

The state of inorganic chemistry in the early nineties of the last century showed some traces of the conditions which too exclusive a reverence for experiment is apt to bring about. The inspiration of the atomic idea was manifestly dying, yet any whisper that the atom might not be the ultimate unit of reality was apt to be snubbed as speculative and unscientific. Nevertheless this impeccable science could tolerate for many years a discrepancy of the order of 1 per cent in the results of the different methods of preparing nitrogen, and with all its faith in experiment could ascribe the discrepancy to experimental error. And all the while, behind the meagre veil of this experimental error the inert gases of the air were impatiently awaiting discovery. The agitated scepticism with which the discovery of argon was received, no less than the great growth of which that discovery was the germ, illustrated how much chemistry had for the moment lost the aptitude for new ideas and the elasticity of mind which their currency produces.—The Collected Papers of Wilfred Trotter, F.R.S. London, Oxford University Press, 1946, p. 122.
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