The Effects of Exercise on Serum Potassium Levels*


In view of the significant influence of potassium on the heart, a decision was made to study the effect of exercise on this important ion in two exercise groups of different intensity. The first group consisted of 44 individuals with known coronary artery disease participating in a supervised cardiac rehabilitation program while the other consisted of 30 healthy joggers. Postexercise mean potassium levels were higher in both groups than resting baseline values. In addition, 5 of 44 participants in the coronary artery disease group experienced major potassium increases of 0.9 mmol/L or more while 7 of 30 healthy joggers experienced this magnitude of increase. Remaining unanswered is the question of whether such abrupt rises in potassium levels in this subset of patients alter their vulnerability to cardiac rhythm and conduction disturbances. A question is also raised as to whether rapid return of potassium levels to baseline postexercise contributes to any risks. (Chest 1992; 101:398-400)

Potassium is an important ion having a significant influence on cardiac rhythm and conduction. While the serum concentration of potassium is known to increase in the face of anaerobic exercise, laboratory studies indicate that vigorous aerobic exercise without acidosis also leads to an increase. The adverse effects of an elevated serum potassium level are well known and include myocardial flaccidity, bradycardia, and a tendency toward atrioventricular block. Given these considerations and the intense public interest in exercise, we decided to study the effects of aerobic exercise on serum potassium levels.

METHODS

To determine the effect of exercise on potassium levels, we obtained before and after exercise blood samples from two groups of people, a combined total of 74 individuals. Participants in this project were asked to sign informed consent forms. This study was approved by the University of Mississippi’s Institutional Review Board on March 22, 1988.

Group 1 consisted of middle-aged and older men and women with history of myocardial infarction and/or coronary artery bypass surgery (age range, 45 to 71 years). All of the individuals in group 1 were participants in well-supervised programs of aerobic exercise at 60 to 80 percent of age-adjusted maximum heart rate. Exercise was conducted through a series of workstations that included stationary bicycles, rowing machines, treadmills, and related devices. All participants exercised for 30 to 45 min.

Group 2 consisted of healthy, younger (age range, 23 to 63 years) men and women who were regularly exercisers with jogging as their primary form of exercise. Distance run ranged from two to seven miles on the day they were studied. All jogged for 30 to 45 minutes. As with group 1, these individuals also exercise to 60 to 80 percent of their age-adjusted maximum heart rate.

For each group a baseline serum potassium level was obtained without a tourniquet just prior to exercising. Both groups completed their exercise regimens as described at a phlebotomy station and a second serum potassium sample was drawn immediately without a tourniquet. There was no appreciable delay between completion of exercise and phlebotomy. All postexercise determinations for both groups were carried out by the same laboratory (using DADOS instrumentation by Coulter Electronics). All procedures were conducted by technicians or technologists certified by the American Society of Clinical Pathologists. In a few instances, specimens were observed to be hemolyzed. These were excluded from calculation of mean potassium values. Likewise, in no case was an exercise potassium increase that was associated with hemolysis in the postexercise specimen counted as a participant demonstrating a post exercise rise.

RESULTS

In group 1 (the coronary artery disease [CAD] group), there were 44 individuals, 9 of whom were women. Mean serum potassium was analyzed for 43 participants and was 4.55 preexercise and 4.8 postexercise (p = 0.09). Of the total group of 44, 21 participants (48 percent) experienced an increase of at least 0.3 mmol/L after exercise with four experiencing an increase of more than 1 mmol/L (two increased by 1.1 mmol and the other two by 1.2 mmol). A fifth group 1 participant had an increase of 0.9 mmol/L. Therefore, 11 percent of this total group had an impressive increase of 0.9 mmol or more.

In the other, younger and more healthy group (group 2), there were 30 participants, 6 of whom were women. In this group, the mean potassium level, among 29 for whom analysis was carried out (Table 1), was 4.15 preexercise and 4.7 postexercise (p = 0.02). Twenty-three (77 percent) of the 30 exercisers in this group experienced an increase of at least 0.3 mmol/L. Furthermore, a number of exercisers in this younger and healthier group (group 2) had impressive increases in their serum potassium levels with seven showing

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Exercise and Serum Potassium Levels (Hutchinson, Barksdale, Watson)
Table 1—Participants with a Potassium Increase of at Least 0.9 mmol/L.

<table>
<thead>
<tr>
<th>Group 1</th>
<th>Group 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total No. of participants</td>
<td>44</td>
</tr>
<tr>
<td>No. with potassium increase ≥0.9</td>
<td>5</td>
</tr>
<tr>
<td>% with increase ≥0.9</td>
<td>11.36</td>
</tr>
<tr>
<td>Greatest potassium increase, mmol/L</td>
<td>1.2</td>
</tr>
</tbody>
</table>

Increases by at least 0.9 mmol/L in the postexercise sample, constituting a much higher percentage of individuals with a rise than in the group 1 CAD exercise participants (23 percent vs 11 percent). The difference, however, was not statistically significant.

Discussion

As indicated in the introduction, an exercise-induced rise in the serum potassium level is not limited solely to those engaging in anaerobic exercise but can transpire with vigorous aerobic activity also.2,3 Ljunghall et al4 exercised a group of individuals with bicycle ergometry and observed an increase in potassium levels with prolonged isotonic exercise in the absence of acidosis. Furthermore, Coplan et al5 exercised 15 men on a treadmill with an indwelling venous catheter. The participants were divided into two groups, those exceeding and those not exceeding the lactate threshold. While the former group experienced the greatest potassium increase, the latter group also experienced a significant rise.

Fletcher et al6,8 have shown with maximal treadmill exercise tests that potassium and magnesium levels increased postexercise. Potassium increases were in the range of 1 mmol/L or greater. It was also shown in these studies that pretreatment with atenolol or propranolol did not affect the rise in potassium immediately postexercise. It was shown, however, that propranolol prolonged the time of return of plasma potassium to baseline after exercise. It was further determined in these studies that hyperkalemia with maximal exercise testing increases after training with atenolol and propranolol compared with placebo and that this effect resolves once treatment is discontinued.

In reviewing the literature,2,10-12 it appears that the increase seen in serum potassium levels with aerobic exercise is in part due to hemoconcentration (which appears to occur rather quickly) and in part is due to the local release of potassium from skeletal muscle into the interstitial fluid. The basis for the latter is a source of speculation, but several possible explanations may be offered. One of these is that the simple squeezing action of muscular contraction might force potassium out of muscle cells and into the circulation. One might also speculate that transient, momentary ischemia of muscle cells could occur even with aerobic exercise and be associated with the escape of some potassium from the exercising muscle. Since potassium causes vasodilatation,2,13,14 the transient ischemia would in this case serve the useful purpose of leading to an increase in blood flow to the working muscles. On the other hand, an excessively high serum potassium level can have a number of specific adverse effects on the heart such as those enumerated at the beginning of this article.

In contrast to other studies, our project was unique in including an important out-of-the-laboratory, “real world” component, ie, a group of joggers. Our study also identified an important subgroup of aerobic exercisers (in both the cardiac rehabilitation and jogger groups) who experienced an abrupt and impressive increase in their serum potassium level with exercise, ie, 0.9 mmol/L or more.

Conclusion

In conclusion, our study confirms the fact that a significant number of individuals will experience an increase in serum potassium levels with isotonic exercise and that, in some, the increase will be of impressive proportions. Whether such acute increases in potassium adversely affect cardiac rhythm and conduction is an important question remaining to be answered. Nevertheless, it remains true that for most people, the cardiovascular risks of exercise are quite low.15,17

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Grossmont Hospital, La Mesa, California, will present this symposium April 4 at the San Diego Convention Center. For information, contact Verda Belyeu, Grossmont Hospital, PO Box 158, La Mesa, California 91944-0158 (619:589-4153).

References

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