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The Effect of Regional Application of Short Wave Diathermy on the Blood Pressure and Diuresis

An Experimental Study on Rats and Rabbits

ERKKI J. VALTONEN

Department of Physical Medicine, University Central Hospital, Helsinki, Finland

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Die Wirkung einer örtlichen Kurzwellendiathermie auf Blutdruck und Diurese

Zusammenfassung. Eine Behandlung der Nierengegend von Kaninchen hatte keine Wirkung auf Blutdruck und Diurese. Dagegen verursachte eine Behandlung von Kopf und Hals einen vorübergehenden significanten Abfall der Diurese infolge eines gleichzeitigen vorübergehenden Abfalls des Blutdruckes.

Summary. Treatment of the region of the kidneys of rabbits had no effect on the blood pressure and diuresis. On the other hand, treating of the region of the head and neck caused a transient significant decrease in the diuresis due to a simultaneous transient reduction of the blood pressure.

Perusal of the literature will reveal that hundreds of different conditions or diseases have been treated in the past by short wave diathermy with varying degrees of success. The present view is that the chief therapeutic effect of short wave diathermy is heat production in the tissues. It is therefore apparent that short wave diathermy is indicated when deep heat will assist the physiological response of the tissues to bring about a reversal of the pathological change which is present (SCOTT, 1965).

According to some studies, good results have been obtained in anuria by the application of short wave diathermy locally to the region of the kidneys (BIERMAN, 1938; SCHLIEPHAKE, 1960). The effect was suggested to be due to stimulation of the blood circulation in the kidney. However, because the material reported in the literature was too limited to permit of any definite conclusions, some more accurate experiments were done.

Materials and Methods

To produce a profuse diuresis adult Sprague-Dawley rats (weighing 220 ± 20 g) were hydrated by injecting intraperitoneally 4 per cent of body weight of physiological saline in 5 per cent glucose when the experiment was begun. The animals were then placed in pairs in glass containers adjusted for the collection of urine. The amount of urine excreted was measured at intervals of 15 minutes. The treatment with short wave diathermy was given with the aid of a Siemens Ultratherm 200 H short wave diathermy apparatus. The metal plates of the electrodes were placed on both sides of the glass container. The dose applied was chosen to be "therapeutic" and therefore it caused no special reactions in the behaviour of the animals.

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For additional studies adult male rabbits of an average weight of 2.9 kg (2.7—3.4 kg) were used. The animals were anaesthetized with intravenous Nembutal® and were given physiological saline in 5% glucose or 10% mannitol by continuous intravenous drip. For collection of urine a catheter oiled with vaseline was pushed into the bladder and the quantity of excreted urine was measured at intervals of 5 minutes. The rate of the drip was adjusted so that a continuous diuresis equal in quantity at all times was brought about. Blood pressure readings were recorded with the aid of a cannulated artery which was connected through a semirigid plastic tube filled with saline to a mercury manometer, so constructed that the movements of the column did not demand much blood loss from the animal. The blood pressure was thus read directly in millimetres on the smoked drum.

The region of the kidneys and the region of the head and neck were treated separately with short wave diathermy using small glass-covered electrodes and a "therapeutic" dose of current; the current powers that caused some reaction in the behaviour of the animals under slight anaesthesia were considered to be too strong.

Results

The effect of hydration on the diuresis of untreated control rats is presented in Fig. 1. It is to be seen that the hydration causes an increased diuresis which

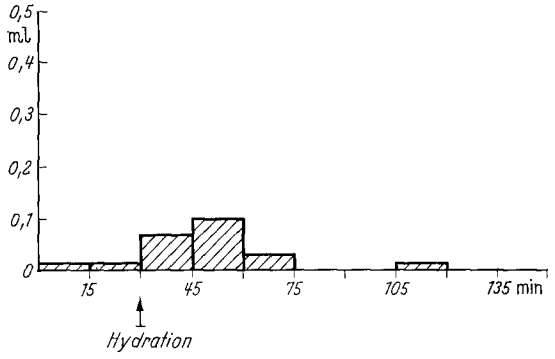

Fig. 1. The effect of hydration on diuresis in the control animals. The columns represent the mean values of eight rats. The urine volumes are stated in millilitres in 15 minutes per rat

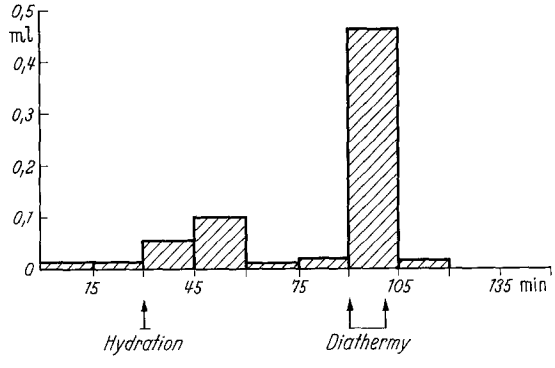

Fig. 2. The effect on diuresis of hydration combined with treatment with short wave diathermy. The columns represent the mean values of sixteen rats. The urine volumes are stated as in Fig. 1

lasts about 45 minutes, after which the diuresis returns to the normal level. The effect of the treatment with short wave diathermy is presented in Fig. 2. It is to be seen that the application of 10 minutes of short wave diathermy at a time the diuresis had already returned to normal caused a great increase in diuresis.

This increase was rapid and of short duration, and it was probably only due to the emptying of the bladder. Therefore safe conclusions concerning the effect of short wave diathermy on the diuresis could not be drawn on the basis of this kind of experiments.

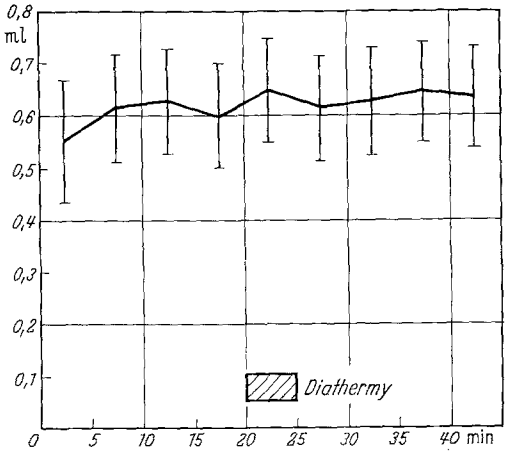

Fig. 3. The effect on diuresis of treatment with short wave diathermy applied to the region of the kidneys. The points represent the mean values ± SE of ten rabbits. The urine volumes are stated in millilitres in 5 minutes per rabbit

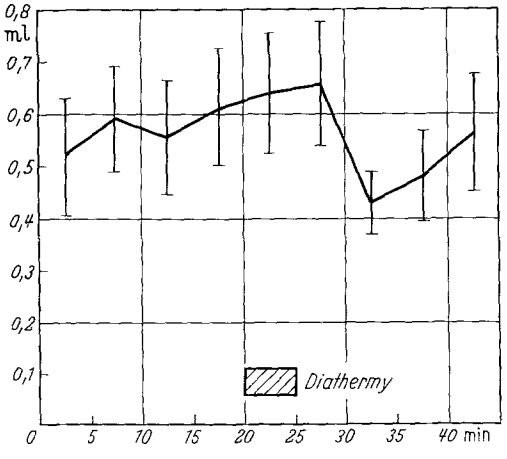

Fig. 4. The effect on diuresis of treatment with short wave diathermy applied to the region of the heat and neck. The points represent the mean values ± SE of ten rabbits. The urine volumes are stated as in Fig. 3

Exposure of the region of the kidneys to short wave diathermy caused no changes in the diuresis and in the blood pressure of the rabbits, as can be seen in Figs. 3 and 5B. On the other hand, when the region of the head and neck was treated there was a transient but significant reduction of the diuresis (Fig. 4). This phenomenon appeared to be caused by a transient reduction of blood pressure, which dropped by about 15 to 20 mm of mercury (Fig. 5A). The transient reduction of the blood pressure and the corresponding diminution of the diuresis were

observed in practically every rabbit tested. On the other hand, the quality of the solution given intravenously for production of the diuresis had no significance, i.e. the reaction type was the same as presented above regardless of whether physiological saline, glucose or mannitol was used.

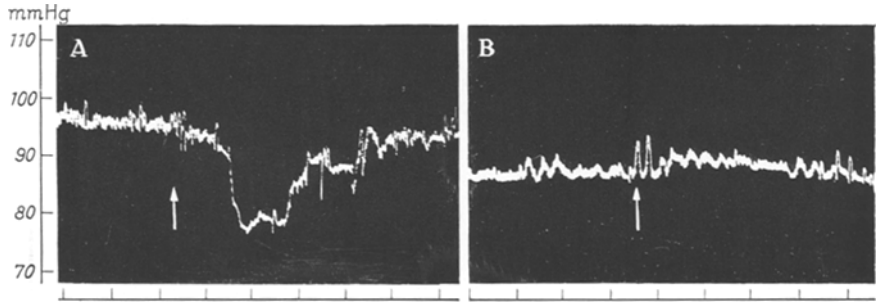

Fig. 5. The effect on blood pressure of treatment with short wave diathermy applied to the region of the head nad neck (A) and to the region of the kidneys (B). The beginning of the treatment is indicated by arrows. Time marks: 1 minute

Discussion

It is evident that treatment with short wave diathermy should not be used if it will not assist the tissues with pathologic changes to recover or, what is more important, if it will accelerate the pathologic process (SCOTT, 1965). Therefore the effect of short wave diathermy on the diuresis is of great theoretical interest and has also some clinical importance.

The results obtained in this study show without doubt that short wave diathermy cannot stimulate diuresis. On the contrary, due to the effect on the blood pressure it has a transient decreasing effect on the diuresis.

When heat is applied to the living animal body the blood vessels become dilated. This phenomenon was not, however, strong enough to cause changes in the blood pressure when the short wave diathermy was applied to the region of the kidneys. There were no changes in the diuresis. These facts point to the probability that short wave diathermy causes no changes in the perfusion of the kidneys.

What is the mechanism that reduces the diuresis when short wave diathermy is applied to the region of the head and neck? It has been shown that heat causes a release of anti-diuretic hormone (ITOH). On the other hand, VANNOTTI observed that stimulation of the region of the carotid sinus by heat, particularly by short wave currents, produced a prompt reaction of the circulatory system in man and animals, characterized by a sudden decline of the blood pressure. This hypotension, the level of which depended upon the degree and duration of the current application, returned to normal after the end of the short wave treatment of the healthy organism. This latter mechanism seems to be the more probable one also in the present study.

In this study the response of only healthy kidneys to short wave diathermy was examined, and as far as the therapeutical increase of diuresis is concerned the results were negative. What is the effect of short wave diathermy on the kidney damaged for instance by shock is unknown. The dilation of contracted

capillaries caused by short wave diathermy may be of benefit and increase the perfusion of the kidney. Increasing of the metabolism of ischaemic tissues and induction of acidosis are, however, harmful effects. As can easily be seen, this entire problem is connected with all the manifold pathological mechanisms of shock and cannot therefore be cleared up even theoretically.

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Dr. ERKKI J. VALTONEN
Meilahden sairaala
Helsinki, Finland