"SELF-TAMING" OF SUXAMETHONIUM AND SERUM POTASSIUM CONCENTRATION

D. A. MAGEE AND E. G. GALLAGHER

SUMMARY

Fifty patients undergoing routine surgery were randomly divided into two groups. Group 1 were pretreated with a small (10-mg) dose of suxamethonium ("self-taming") before administration of suxamethonium 1 mg kg\(^{-1}\), while group 2 received no pretreatment. Potassium concentrations were measured immediately before induction of anaesthesia and, subsequently, for 7 min. A small increase in mean plasma potassium concentration was seen in the group who were not pretreated, while the patients who received a "self-taming" dose of suxamethonium showed a sustained decrease below pre-induction values. Mean plasma potassium concentrations were significantly less in the "self-taming" group than in the group not pretreated.

Increases in serum potassium concentration following single paralysing doses of suxamethonium are well documented (Weintraub, Heisterkamp and Cooperman, 1969; List, 1967). Various forms of pretreatment have been demonstrated to modify this increase, although none abolish it totally (table I). The concept of pretreatment with small doses (10 mg) of suxamethonium was introduced by Baraka in 1977. He showed that such "self-taming" was associated with diminished fasciculations, that the technique was not associated with paradoxical antagonism, and that the resulting neuromuscular blockade was normal in timing and intensity.

The purpose of this study was to investigate the effects of self-taming on the increase in serum potassium concentration associated with the administration of suxamethonium.

PATIENTS AND METHODS

Fifty patients (A.S.A. class 1) undergoing routine surgery and tracheal intubation were studied. All patients were visited before the operation and informed consent obtained. The procedure was approved by the hospital ethics committee. No patient had renal, hepatic or neuromuscular disease, nor was any receiving medication known to affect the serum potassium concentration. Pre-medication consisted of pethidine 50 mg and atropine 0.6 mg i.m. 1 h before operation. Patients were allocated randomly to two groups of 25.

Anaesthesia was induced with thiopentone 4 mg kg\(^{-1}\), and maintained with 70% nitrous oxide in oxygen. Patients in group 1 received a "self-taming" dose of suxamethonium 10 mg immediately after the induction of anaesthesia. Patients in group 2 (controls) received no pretreatment. All patients were given a neuromuscular blocking dose of suxamethonium 1 mg kg\(^{-1}\) 45 s after induction (Baraka, 1977).

Serum potassium concentration was determined in samples of venous blood taken (without tourniquet) from the contralateral arm before induction, immediately before the paralysing dose of suxamethonium and, subsequently, at 1-min intervals for 6 min. The operation did not start until the last sample had been taken. Potassium concentration was measured using an Instrumentation Laboratory model 543 Digital flame photometer. An indication of the accuracy of the measurement is provided in table II. Data were analysed by Student's \(t\) test.

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TABLE II. Evidence of precision in analyses of potassium concentration (mmol litre\(^{-1}\)) (n = 31)

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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Range of values</td>
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<tr>
<td>Sample mean</td>
<td>5.34</td>
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<tr>
<td>Sample variance</td>
<td>2.45</td>
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<tr>
<td>Sample standard deviation</td>
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<tr>
<td>Coefficient of variation</td>
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</tr>
</tbody>
</table>

RESULTS

The mean plasma potassium concentrations (± SEM) for the two groups are shown in table III. The values obtained after induction are expressed as differences from induction (± SEM). Mean plasma potassium concentrations did not differ significantly between the two groups before induction.

In the “self-taming” group, there was a decrease in mean potassium concentration of 0.33 mmol litre\(^{-1}\) (range 3.1–4.4 mmol litre\(^{-1}\)) after induction of anaesthesia and mean potassium concentrations remained below pre-induction values for the duration of the study. One minute after the administration of the full paralysing dose of suxamethonium, there was a small decrease in potassium concentration of 0.11 mmol litre\(^{-1}\) (range 3.3–4.5 mmol litre\(^{-1}\)) (fig. 1) followed by a more gradual decrease. Mean plasma potassium concentrations were significantly less than pre-induction values (P < 0.05) at 6 and 7 min.

In the control group there was a decrease in mean plasma potassium concentration of 0.16 mmol litre\(^{-1}\) (range 3.5–4.4 mmol litre\(^{-1}\)) after induction of anaesthesia. After the administration of the paralysing dose of suxamethonium, mean plasma potassium concentration increased above pre-induction values, the maximum increase of 0.23 mmol litre\(^{-1}\) (range 3.6–5.0 mmol litre\(^{-1}\)) being noted 3 min after the administration of the suxamethonium. The difference between the mean plasma potassium concentrations in the two groups was significant at 3 min (P < 0.05) and, thereafter, the mean concentrations remained significantly different for the period of observation.

TABLE III. Pre-induction values and mean changes ± SEM in plasma potassium concentration (mmol litre\(^{-1}\)) at 1-min intervals following suxamethonium. * = Significance of the difference between the values of the two means. + Significant change from pre-induction value (P < 0.05)

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Before induction</th>
<th>Time (min)</th>
<th></th>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>“Self-taming”</td>
<td>25</td>
<td>4.15±0.08</td>
<td>-0.33±0.11</td>
<td>-0.22±0.07</td>
</tr>
<tr>
<td></td>
<td></td>
<td>n.s.</td>
<td>n.s.</td>
<td>n.s.</td>
</tr>
<tr>
<td>Control</td>
<td>25</td>
<td>4.03±0.09</td>
<td>-0.16±0.06</td>
<td>+0.11±0.06</td>
</tr>
<tr>
<td>Time (min)</td>
<td></td>
<td></td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>“Self-taming”</td>
<td>25</td>
<td>-0.19±0.07</td>
<td>-0.23±0.07</td>
<td>-0.25±0.04*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>P &lt; 0.05</td>
<td>P &lt; 0.01</td>
<td>P &lt; 0.01</td>
</tr>
<tr>
<td>Control</td>
<td>25</td>
<td>+0.23±0.03</td>
<td>+0.21±0.04</td>
<td>+0.16±0.05</td>
</tr>
</tbody>
</table>
SELF-TAMING OF SUXAMETHONIUM

DISCUSSION

In normal adults the administration of suxamethonium i.v. is associated with an increase in serum potassium concentration of up to 24% (Masse, Escue and Houston, 1969). Serious or even fatal hyperkalaemia may occur in susceptible patients in whom maximum potassium concentrations of greater than 10 mmol litre\(^{-1}\) have been reported (Iwatsuki et al., 1980). Susceptibility to such suxamethonium-induced hyperkalaemia was first reported in patients with extensive burns during the catabolic phase of recovery (Allan, Cullen and Gillies, 1961). A similar response has been demonstrated in patients with multiple injuries, crush injuries, major neurological injuries and in various neurological and muscular diseases.

A number of measures attenuate but do not prevent the release of potassium after suxamethonium (table I). Massive hyperkalaemia has been shown to occur despite pretreatment with tubocurarine (Stevenson and Birch, 1979).

The figures presented here show that the technique of “self-taming” inhibits this increase in normal patients, and a sustained decrease in mean potassium concentrations was seen for up to 6 min after a full paralysing dose of suxamethonium. The source of potassium is the muscle cell (Bali and Dundee, 1974a). The stimulus to potassium release may be either muscle depolarization (Gronert, 1980) or result from muscle trauma attributable to fasciculations (Weintraub, Heisterkamp and Cooperman, 1969). Baraka has suggested that the taming effects of small doses of suxamethonium may be attributed to neuromuscular accommodation or desensitization, or both. The subsequent full dose of suxamethonium may then produce blockade without actual electrical excitation of the neuromuscular junction. Thus, suxamethonium-induced fasciculations and electrical depolarizations of the muscle cell membrane may be eliminated as a source of suxamethonium-induced potassium release. The decreases in potassium concentration shown in figure 1 are similar to those seen when anaesthesia is induced with thiopentone before the administration of suxamethonium (Bali and Dundee, 1974b). These findings agree with those of Charak and Dhar (1981) who showed a significant decrease in serum creatine phosphokinase concentration following such a “self-taming” technique.

"Self-taming" was observed by Baraka (1977) to diminish suxamethonium-induced muscle fasciculations. Subsequent studies have shown that such pretreatment does not prevent myalgia after operation (Brodsky and Brock-Utne, 1979) but may diminish the suxamethonium-induced increase in intraocular pressure (Verma, 1979) although that is debatable (Meyers, Singer and Otto, 1980). More recently, it has been demonstrated that “self-taming” is associated with marked changes in cardiac rate and rhythm and does not protect the heart against the arrhythmias caused by subsequent doses of suxamethonium (Magee, Sweet and Holland, 1982). Despite the favourable effects shown here of “self-taming” on suxamethonium-induced potassium release, the technique appears to have limited clinical applicability.

REFERENCES


**"SELBST-ZÄHMUNG" VON SUXAMETHONIUM UND SERUMKALIUM-KONZENTRATION**

**ZUSAMMENFASSUNG**


**AUTO-DOMINIO DEL SUXAMETONIO Y CONCENTRACION DE POTASIO EN EL SUERO**

**SUMARIO**

Se distribuyeron al azar en dos grupos a cincuenta pacientes sometidos a cirujia corriente. Se traté previamente al Grupo 1 con una pequeña dosis (10 mg) de suxametonio (auto-dominio) antes de administrarles 1 mg kg⁻¹ de suxametonio, mientras que no se dio ningún tratamiento al Grupo 2. Se midieron las concentraciones de potasio, inmediatamente antes de la inducción de la anestesia y, consecuentemente, a los 7 min. Se observó un pequeño aumento de la concentración media del potasio en el plasma en el Grupo que no recibió premedicación, mientras que los pacientes a quienes se dio una dosis de "auto-dominio" de suxametonio demostraron un descenso sostenido por debajo de los valores de preinducción. Las concentraciones medias de potasio en el plasma eran mucho más bajas en el grupo de "auto-dominio" que en el Grupo sin pretratamiento.