THE PREVENTION OF MUSCLE PAINS ASSOCIATED WITH THE USE OF SUXAMETHONIUM

BY

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SUMMARY

The incidence and severity of muscle pain was assessed in 150 males who underwent bronchoscopy using thiopentone and suxamethonium iodide or chloride for anaesthesia. In 50 patients tubocurarine 3–5 mg, diplacin 10–15 mg or kvalidil 10–15 mg was injected intravenously after the induction dose of thiopentone. In a further group of 50 patients neostigmine 0.5–0.75 mg was injected intramuscularly 20–30 minutes after bronchoscopy. The remaining 50 patients were not given either of these treatments and formed a control group. Six patients developed pain when non-depolarizing relaxants had been used compared with 29 in the neostigmine group and 40 in the control group.

Whilst muscle pains following the use of suxamethonium are not dangerous, they add appreciably to the patient’s postoperative discomfort. There is continued interest in methods by which these pains can be prevented from occurring and in this communication is described the results of an investigation of the prophylactic value of a small dose of non-depolarizing relaxants and of neostigmine.

METHODS

The investigation was carried out in 150 males aged 29 to 47 suffering from inflammatory disease or tumours of the lung for which diagnostic bronchoscopy was required. Ill or poor-risk patients were not included in the trial. All patients had moderately or well developed musculature. The instrument used for bronchoscopy permitted controlled respiration to be continued throughout the procedure.

The patients were divided into three groups of 50 patients, as follows:

Group I. After premedication with atropine 0.5–0.75 mg given intramuscularly 30–40 minutes before the procedure, the patient breathed 100 per cent oxygen for 3–4 min; 2 per cent thiopentone was then injected until the patient lost consciousness, after which tubocurarine 3–5 mg, diplacin* 10–15 mg, or kvalidil* 10–15 mg was injected. After ensuring that there was no marked respiratory depression or muscle relaxation, suxamethonium iodide or chloride 120 mg was injected 60–80 seconds later. (The iodide or chloride is equally likely to be followed by muscle pains.)

In Group II a similar technique was used except that non-depolarizing relaxants were not injected and neostigmine 0.5–0.75 mg was injected intramuscularly 20–30 minutes after bronchoscopy. Atropine was not injected with neostigmine.

Group III. The procedure was carried out as described but neither non-depolarizing relaxants nor neostigmine were used. This group acted as a control.

Postoperatively the patients were visited by a physician who had no knowledge of the groups to which patients had been assigned. Pains were classified in three degrees according to the duration and severity.

Mild—slight poorly localized muscle pains. Often these patients did not complain of pains, and their presence was revealed only upon inquiry.

Moderate—pains in cervical muscles and extremities. As a rule patients complained about these pains which often continued for up to 24 hours.

Severe—pains in all parts of the body; these persisted for 2 days. In some patients these pains were so severe as to prevent free movement in the bed.
The intensity of muscle fibrillation was recorded in each case. The serum potassium level was determined in the patients of the control group during anaesthesia and on the second post-operative day.

RESULTS

Table I shows the frequency and severity of muscle pain developing in patients in the three groups. It is seen that no patients in the group of patients to whom non-depolarizing relaxants were given developed severe pain compared with 23 of 50 in the control group. Whereas only 10 patients of the control group were reported to be entirely without pain, 44 of the non-depolarizing relaxant group were free from pain. In the group of patients in whom neostigmine was injected the results were substantially better than those of the control group, but did not approach those obtained when non-depolarizing relaxants had been given before injection of suxamethonium.

The relationship of the frequency and intensity of muscle pain to the frequency and intensity of the observed fibrillary contractions is shown in table II. This refers to the results obtained in the control group and the non-depolarizing relaxant group. It can be seen that the frequency and severity of after-pain increased with increasing intensity of muscle fibrillation.

Figure 1 shows the changes in serum potassium concentration of patients in the control group. The concentration of potassium in blood serum fell after the injection of thiopentone from $5.26 \pm 0.38$ m.equiv/l. to $5.05 \pm 0.41$ m.equiv/l. Two to four minutes after the injection of suxamethonium the level of potassium in blood serum rose to $5.56 \pm 0.40$ m.equiv/l. At this time passive pulmonary hyperventilation was employed to ensure adequate gas exchange. At the end of endoscopic examination, when spontaneous respiration had completely recovered, the level of potassium in blood serum fell to $5.28 \pm 0.35$

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**Table I**

The frequency and severity of pain developing in the muscles of 150 patients after bronchoscopy carried out under anaesthesia as described in the text.

<table>
<thead>
<tr>
<th>Group</th>
<th>Type of anaesthesia</th>
<th>Total number of patients</th>
<th>The frequency and severity of pains</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Barbiturates + non-depolarizing muscle relaxants + suxamethonium</td>
<td>50</td>
<td>Absent</td>
</tr>
<tr>
<td>I</td>
<td>Barbiturates + suxamethonium + neostigmine</td>
<td>50</td>
<td>44</td>
</tr>
<tr>
<td>II</td>
<td>Barbiturates + suxamethonium</td>
<td>50</td>
<td>21</td>
</tr>
<tr>
<td>III</td>
<td>Barbiturates + suxamethonium</td>
<td>50</td>
<td>10</td>
</tr>
</tbody>
</table>

**Table II**

The relationship between the severity of fibrillary contractions and muscle pains. Data from control group and group in which non-depolarizing relaxants were used (100 patients).

<table>
<thead>
<tr>
<th>Fibrillary contractions</th>
<th>Number of patients</th>
<th>Absent</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absent</td>
<td>43</td>
<td>36</td>
<td>6</td>
<td>1</td>
<td>—</td>
</tr>
<tr>
<td>Mild</td>
<td>17</td>
<td>8</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Moderate</td>
<td>22</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>Severe</td>
<td>18</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>52</td>
<td>15</td>
<td>10</td>
<td>23</td>
</tr>
</tbody>
</table>
The level of potassium in blood

![Graph showing changes in serum potassium level](image)

**DISCUSSION**

Reported incidences of muscle pains after suxamethonium have ranged from 20 to 90 per cent (Churchill-Davidson, 1954; Mayrhofer, 1959; Kovan et al., 1960; Parbrook and Pierce, 1960; Burtles, 1961; White, 1962; Bennike and Nielsen, 1964). They usually appear in patients subjected to light anaesthesia of short duration and are commonly reported after bronchoscopy performed under intravenous barbiturate anaesthesia with the use of depolarizing muscle relaxants. In the authors' experience, however, muscle pains are rare after short operations performed under anaesthesia in which depolarizing muscle relaxants are used. This is in agreement with the reports of Churchill-Davidson (1964), Foster (1960), and White (1962), who also in most cases observed muscle pains in out-patients and after endoscopic manipulations.

Although muscle pains were reported as long as 15 years ago (Bourne, Collier and Somers, 1952; Dardel and Thesleff, 1952), the aetiology is still unknown. König's (1956) supposition that they are dependent upon the accumulation of lactic acid in muscle or products of hydrolysis of suxamethonium (Konow, 1959) was not confirmed by Foldes (1959).

Some authors (Klupp and Kraupp, 1954; Kostin, 1963; Shanin, Uvarov and Kivik, 1963) think that the appearance of muscle pains is related to the release of potassium from cells which is associated with the use of depolarizing relaxants. Indeed, serum levels rise slightly. In addition there occurs a breakdown of glycogen during fibrillary contractions, liberating intracellular potassium with accumulation of lactic acid and tissue acidosis. The latter impedes the retention of intracellular potassium (Fenn, 1936, 1940, 1955).

Our results also indicate that there is some increase of potassium concentration. Nevertheless suxamethonium only slightly raises the level of serum potassium because barbiturates (and ether) in their turn lower it to some extent. It is also of interest that at the moment of maximum severity of pain, about 24 hours after suxamethonium, the serum potassium level is not changed significantly in comparison with the initial level (fig. 1). We do not consider, therefore, that the loss of potassium from the cells, of itself, accounts for the development of muscle pains.

Most authors relate the appearance of pains after the use of suxamethonium to muscle fibrillation. Mayrhofer (1959) considered that, during fibrillation, microtrauma of muscles might occur; his histological investigations did not confirm this, however.

Our observations agree with the opinions of other investigators that the frequency and intensity of muscle pains depends upon the intensity of fibrillary contraction.

As is evident from table II, as the frequency and intensity of suxamethonium-induced fibrillations increased, so muscle pains increased in frequency and intensity.

The methods proposed to prevent the development of muscle pains include the use of neostig-
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mine after anaesthesia (König, 1956; Mayrhofer, 1959), the slow injection of suxamethonium (Hegarty, 1956), injection of vitamin B, before suxamethonium injection (König, 1958), intravenous injection of lignocaine (Wikinski et al., 1965). Injection of decamethonium (Hegarty, 1956) and of non-depolarizing muscle relaxants (Churchill-Davidson, 1954) before suxamethonium have each been recommended. The authors have tried most of these methods but decided on the two that seemed most effective according to clinical impression.

In this investigation the use of non-depolarizing relaxants proved very effective and the results are in agreement with those reported by others (Churchill-Davidson, 1954; Mayrhofer, 1959; Leatherdale et al., 1959; Burtles, 1961; White, 1962; Bennike and Nielsen, 1964; Kreischer et al., 1965; Hodges, 1957; Foster, 1960). Bryson and Ormston (1962) objected to the use of this method for the prevention of pain on the grounds that the recovery of adequate ventilation might be delayed. The employment of small doses of tubocurarine (3–5 mg) or other non-depolarizing muscle relaxants before the use of suxamethonium according to our experience, does not delay recovery of respiration and can be safely used for preventing the development of muscle pains.

It is concluded that injection of neostigmine (0.5–0.75 mg) at the end of anaesthesia somewhat reduces the frequency of appearance of muscle pains, but that the injection of minimal doses of non-depolarizing muscle relaxants (tubocurarine 3–5 mg, diplacain 10–15 mg, or kvalidil 10–15 mg) before the injection of suxamethonium almost completely prevents the development of muscle pains.

REFERENCES


This book is a collection of forty-eight of about one hundred papers which were presented at the International Congress for Hypnosis and Psychosomatic Medicine held in Paris in 1965. The proceedings cover a wide variety of subjects and the lecturers come from all parts of the world. Translation difficulties have caused considerable delay in publication and spelling errors still remain. Just over a half of the articles are in English, the rest being in French or German, with no English summaries. References are provided in only seventeen papers.

It must be remembered that these lectures have been given to "the converted" and they presume knowledge of the subject. This book is thus no introduction to hypnotherapy but any unbiased reader cannot fail to be absorbed by its contents.

Although some six of these lectures are of direct interest to anaesthetists, many may wonder why such a review appears in an anaesthetic journal or what connection exists between these two subjects. The reviewer has therefore decided to quote two anaesthetists who lectured at this Congress.

Dr. Finer (Sweden) writes: "The anaesthesiologist has long been regarded as the physician-physiologist of the surgical team, but recently, it has been shown that with a dynamic understanding of the doctor-patient relationship and training in hypnosis, he can function as the psychologist of the surgical team."

Dr. Marmer (Beverly Hills, California) reviews uses of hypnosis in anaesthesiology, citing case histories, and ends by saying:

"Hypnosis is an exceedingly potent and effective psychological tool, but it will never do away with chemical anaesthesia. It is recommended principally for special or selected cases. This group constitutes less than 10 per cent of the average anaesthesiologist's practice. Nevertheless, hypnosis is a most valuable adjunct to anaesthesia and should be integrated into the practice of anaesthesiology.

"Some anaesthesiologists may not be suited by temperament or habit to utilize this modality. Others may lack the understanding and the conversational skills necessary for success with this technique. However, there are many anaesthesiologists who have the aptitudes and the personality characteristics that would enable them to give better psychological care to their patients if they were encouraged to do so and if they had greater understanding of the psychodynamics and uses of hypnosis."

The reviewer cannot agree with the figure of 10 per cent which seems high. However, aspects of anaesthesia for which these two authors sometimes find hypnotherapy useful include, inter alia, extreme preoperative fear, alleged multiple "drug allergy", postoperative medication, pain clinic work, recurrent laryngospasm and persistent postoperative hiccup.

Other lectures of anaesthetic interest include States of Awareness during General Anaesthesia (Dr. Levinson, Johannesburg), which is reviewed here in more detail than in his paper in this Journal (1965, 37, 544), Anxiety and Hypnosis (Dr. Meares, Melbourne), and two "physiological" lectures, one from five authors in London and one by Dr. de Moraes Passos, Sao Paulo. Other aspects of hypnotherapy that could concern the "anaesthetist-hypnotist" are on asthma (Dr. Houghton, London) and dermatology (Dr. Fenton, London), both giving a very fair account of its use and limitations; also included are the treatment of pain, epilepsy, phantom limbs and obstetrics (the latter in French). The reviewer feels that fields such as frigidity and impotence, exhibitionism, and alcoholism—also described—are best left to the "psychiatrist-hypnotist."

"It is a pity that one lecture had not been devoted to the modern and more rapid induction techniques, as time is an increasingly important factor today. However, the English lectures alone make most interesting reading for the anaesthetist and could whet the appetite for further study of this subject.

David L. Scott