SUXAMETHONIUM PAINS AND ELECTROMYOGRAPH RECORDINGS IN CHILDREN

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SUMMARY

Surface electromyography was used to investigate muscle activity in children following the administration of suxamethonium. The duration, amplitude and frequency of muscle action potentials recorded in children were similar to those in adults. Twenty-three children had muscle action potential frequencies in excess of 50 Hz, but only two suffered pain after operation. The relationship between high frequency discharge rates of motor units noted in adults in earlier studies does not apply to children.

Postoperative pains following suxamethonium occur much less frequently in children than in adults. Bush and Roth (1961) found an overall frequency of 10% in children aged 5–14 yr. In the 5–9 yr age group the incidence was only 3%, increasing to 23% in the 10–14 yr group. The adult frequency is 66% (Churchill-Davidson, 1954), 72% (Morris and Dunn, 1957), 36% (Leatherdale, Mayhew and Hayton-Williams, 1959), 25% (Hegarty, 1956) and 55% (Collier, 1975).

Collier (1975) made electromyograph (e.m.g.) recordings of the fasciculations following suxamethonium in adults and found a relationship between high frequency discharge rates (greater than 50 Hz) of motor units and pain after operation. He suggested that muscle spindles developed tetanus at discharge rates greater than 50 Hz and suffered damage leading to pain and stiffness, particularly in those muscles with high spindle counts, such as the small muscles of the neck and the lower intercostal muscles.

In view of the low frequency of pains in children, similar e.m.g. recordings have been made to ascertain whether there is any major difference in the muscle activity compared with that of the adult after injection of suxamethonium.

METHOD

Fifty-four children, aged 1½–16 yr, were all undergoing minor ear, nose or throat operations and were expected to be ambulant the next day. A variety of premedications were used, consisting of triclofos and atropine, trimeperazine and atropine, papaveretum and hyoscine, pethidine and promethazine, flunitrazepam and diazepam. Anaesthesia was induced with either cyclopropane in oxygen or thiopentone. Suxamethonium 1.5 mg kg⁻¹ was given to facilitate tracheal intubation and maintenance of anaesthesia was with halothane and nitrous oxide in oxygen.

Surface e.m.g. was recorded on the upper limb using two plate electrodes 3 cm x 1.5 cm in area. One was placed over the belly of the biceps and the other over the belly of the triceps (Hjorth, Walsh and Willison, 1973). The long axes of the electrodes were along the length of the corresponding muscles, and contact electrode jelly was used. Limb temperatures were not recorded but the ambient room temperature was never less than 24 °C. A cool temperature is associated with reduced e.m.g. activity.

Permanent recordings were obtained on light-sensitive paper from a fibreoptic recorder of the MS5 e.m.g. equipment. The paper speed was set at 12.7 cm s⁻¹. The sensitivity was 40 μV cm⁻¹ with adjustments as indicated. The low frequency filter was set with a time constant of 100 ms, the high frequency filter at 30 μs. Recording of muscle activity was begun after induction but before the injection of suxamethonium and continued until activity was undetectable.

A clinical assessment of muscle fasciculations was made and graded (a) none (b) limited to limbs and face, (c) mild generalized fasciculation and (d) severe generalized fasciculation.

The next day a questionnaire similar to that used by Bush and Roth (1961) was completed. The children were first observed by the ward sister with regard to spontaneous complaints of pain. If there were none, the child was then asked “Have you had any pains or stiffness this morning?” If the answer was “Yes” the child was asked where the pains were. If the reply was “No” the child was asked directly if he had any pains...
in his neck, back, chest, tummy, arms or legs. One of us (M. M.) saw every child and conducted a full range of movements and breathing exercises with each child in an attempt to elicit signs of stiffness.

RESULTS

In two out of 54 children e.m.g. did not record any muscle action potentials. This was probably a result of an expired solution of suxamethonium in one case and to poor electrode contact in the other. Both cases were excluded from the study.

The time between the injection of suxamethonium and the onset of e.m.g. activity varied from 4.5 to 34.5 s. Presumably this was related to the site of injection and the cardiac output. The duration of e.m.g. activity ranged from 7 to 61 s with a mean duration of 31.6 s. Occasionally there was difficulty in defining the precise end-point of activity. C. Collier recorded a similar mean duration of 38 s in adults (personal communication).

The peak-to-peak amplitude (maximum negative to positive change) ranged from 3 μV to 1.6 mV, although the mean amplitude was 96 μV and in only five patients was it in excess of 200 μV. Using needle electrodes, Collier recorded amplitudes in the range 60–200 μV, and Meadows (1971) 100–1000 μV.

The frequency of motor unit potentials was assessed using Collier’s technique of counting all the deflections from baseline greater than 18 μV in amplitude during a period of maximum e.m.g. activity. In our patients the period was limited to 1 s, or 2.5 cm of trace (fig. 1).

![Fig. 1. A 1-s strip of surface e.m.g. recording. (Male patient, 4.5 yr.)](image)

The range of frequencies was from 5 to 106 Hz with a mean of 49 Hz. This compares with Collier’s recordings of 23–72 Hz.

Visible fasciculations were recorded as being absent in four patients, limited to minimal movements of face and limbs in 13, mild and generalized in 27 and severe and generalized in eight patients.

Out of 52 children, only three, all girls, were found to have any pains after operation. Their ages were 7, 8 and 13 yr. One of them complained spontaneously of pains in the arms, but developed pyrexia subsequently and was thought to have had influenza. Another child, on direct questioning only, said her arms (deltoid and triceps muscles) were stiff, but this lasted for only a few hours. Mild fasciculations had been observed clinically. The third child, on direct questioning, complained of painful arms, soreness on deep breathing and discomfort in the back. This last child had been noted to have severe visible fasciculations. However, seven other children with severe fasciculations had no pains at all after operation, confirming the findings of Bush and Roth (1961) in children.

Twenty-three children had muscle action potential frequencies in excess of 50 Hz, the figure which, in Collier’s study of adults, marked a significant threshold between the presence or absence of symptoms. The proportion of patients with frequencies greater than 50 Hz (44%) is similar to that found by Collier (55%), but whereas 39 of 42 of Collier’s patients suffered from symptoms, only two of 23 children were found to do so.

DISCUSSION

The results of this study support the earlier findings of a low frequency of suxamethonium-induced pains in children and a preponderance of females amongst those with symptoms (Bush and Roth, 1961). E.m.g. findings were very similar to those in adults. The amplitude is generally less, but this can be explained by the relatively smaller bulk of muscle. The critical threshold discharge frequency of 50 Hz, described by Collier (1975), does not apply in children. It is not believed that children have fewer muscle spindles than do adults and, therefore, would be less vulnerable to damage. Newnam and Loudon (1966) have found that muscular fitness is associated with less pain after operation. Children, particularly boys, are generally extremely active, and this may be a factor contributing to the lower incidence, a point made by Bush and Roth also. If this is the only reason, it is difficult to understand why patients in the age groups 50–60 yr have a low incidence of symptoms (Burtles and Tunstall, 1961; Collier, 1975), unless ageing alters the properties of the muscle spindles.

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REFERENCES


**RESUME**

On a utilisé l'électromyographie en surface pour étudier l'activité des muscles après l'administration de suxaméthonium à des enfants. La durée, l'amplitude et la fréquence des potentiels d'action des muscles enregistrées sur des enfants ont été similaires à celles des adultes: 23 enfants ont eu des fréquences de potentiel de l'action des muscles supérieures à 50 Hz, mais deux seulement ont souffert de douleurs postopératoires. La relation entre les taux de décharge haute fréquence des unités motrices que l'on avait constatée sur les adultes au cours d'études antérieures ne s'applique pas aux enfants.

**ZUSAMMENFASSUNG**


**SUMARIO**

Se empleó electromiografía superficial para investigar la actividad muscular en niños, después del suministro de suxametonio. La duración, amplitud y frecuencia de los potenciales de acción muscular registrados en niños, resultaron similares a las de adultos. Veinte y tres niños tuvieron frecuencias de potencial de acción muscular en exceso de 50 Hz, pero solo dos sufrieron dolores postoperatorios. La relación entre los niveles de descarga de alta frecuencia de unidades motrices notadas en los adultos en estudios anteriores no es aplicable a los niños.
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