THE EFFECT OF SUXAMETHONIUM ON THE INTRAGASTRIC PRESSURE IN INFANTS AND CHILDREN

M. R. SALEM, A. Y. WONG AND Y. H. LIN

SUMMARY

The effect of intravenous administration of suxamethonium on the intragastric pressure was investigated in thirty paediatric patients after induction of anaesthesia. In most patients there was a fall, while in five older children slight rise occurred, the maximum was 4 cm H₂O. This seems to be related to the absence of strong muscle fasciculations, especially in infants and young children. Because of the lack of rise in intragastric pressure, and because of the antagonistic actions of the depolarizing and antidepolarizing types of block, prior administration of tubocurarine is not necessary in paediatric patients with a “full stomach”.

Rapid intravenous induction of anaesthesia and suxamethonium administration followed by tracheal intubation is a commonly used technique in the management of adult patients with a “full stomach”. The technique, however, carries the risk that suxamethonium-induced fasciculations may raise the intragastric pressure sufficiently to overcome the opening pressure of the gastro-oesophageal junction, and induce regurgitation of gastric contents (Snow and Nunn, 1959; Andersen, 1962; Roe, 1962; Wylie, 1963; La Cour, 1969; Miller and Way, 1971). Prior administration of an antidepolarizing muscle relaxant (La Cour, 1970; Miller and Way, 1971) or lignocaine (Mille and Way, 1971) is effective in preventing the muscle twitchings and the concomitant rise in intragastric pressure.

Previous measurements of intragastric pressure changes following intravenous injection of suxamethonium were only done on adult patients. Similar studies on infants and children have not been reported. The purpose of this study was to investigate the effect of suxamethonium administration on the intragastric pressure in paediatric surgical patients.

METHODS

A total number of 30 patients between the ages of 3 weeks and 12 years were chosen for the study. Except for 2 patients, all were to be operated on for elective surgical procedures. Hyoscine (0.1–0.15 mg) was the only premedication given to patients below 1 year of age. The remainder of the patients were premedicated with hyoscine (0.15–0.4 mg) and morphine 0.18 mg/kg body weight. Drugs were given intramuscularly 1 hour prior to the anticipated time of operation. Anaesthesia was induced in the supine position with intravenous thiopentone (4 mg/kg) in 10 patients and halothane (inspired concentration 1–1.5 per cent) in 20 patients.

Intragastric pressures were measured with thin-walled rubber balloons mounted on polyethylene catheters. Different sizes of balloons were used (20–80 ml), depending on the patient’s age. The maximum volume of air that a balloon could hold while still registering zero pressure was initially determined. The lubricated deflated balloon was then introduced into the stomach after anaesthesia had been induced and the predetermined volume of air was injected. Intragastric pressure measurements were recorded using a pressure transducer and a Grass Polygraph. The position of the balloon was verified by the fluctuations in pressure during spontaneous respiration (slight rise during inspiration and fall during exhalation) and by applying manual pressure to the upper abdomen. No attempt was made to reduce intragastric pressure by aspiration of stomach contents.

After a steady state of anaesthesia had been achieved, suxamethonium 1.1 mg/kg was injected in a hand vein while the intragastric pressure was continuously recorded. The intensity of fasciculations as seen on the abdomen was graded by an

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independent observer as follows: absent 0; minimal +; moderate ++; pronounced +++.

Artificial ventilation was not initiated in the first 30 seconds following the injection of suxamethonium, and until the fasciculations had completely ceased. Intubation was then performed. The effect of straining and coughing on the intragastric pressure was elicited in 10 patients by manipulating the tracheal tube after the effect of suxamethonium had worn off and the inhalation anaesthetic was discontinued.

The tracings were examined and the following data were obtained: the pre-suxamethonium intragastric pressure was 13.8 cm H$_2$O (range 4.5–25). After fasciculations had disappeared, the maximum pressure was 4 cm H$_2$O. Almost all patients below 2 years of age had a drop in intragastric pressure, while only 5 developed a slight rise, the intensity of fasciculations in all patients is minimal in infants and young children.

During fasciculations or first minute after injection, the intragastric pressure was 16.5 cm H$_2$O (range 4.5–25). After fasciculations had disappeared, or second minute after injection, the intragastric pressure was 9.6 cm H$_2$O (range 3–17).

The initial changes in intragastric pressure following suxamethonium injection are presented in figure 1. Most of the patients exhibited a fall in pressure, while only 5 developed a slight rise, the maximum was 4 cm H$_2$O. Almost all patients below 4 years of age had a drop in intragastric pressure.

Those that showed a rise were all above the age of 4. The intensity of fasciculations in all patients is presented in figure 2. It was regarded as absent in 12, minimal in 10, moderate in 5, and pronounced in 3 patients. The fasciculations were absent or of minimal intensity in infants and young children. Of the 5 children that developed a rise in intragastric pressure, 3 had pronounced fasciculations.

![Figure 1](image_url)

**FIG. 1.** Changes in intragastric pressure (IGP) in 30 patients during fasciculations or first minute of injection of suxamethonium (when fasciculations were absent). The maximum rise in pressure was 4 cm H$_2$O. (Solid circles, halothane; open circles, thiopentone.)

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### Table I

<table>
<thead>
<tr>
<th>Age</th>
<th>Induction agent</th>
<th>Before sux.</th>
<th>During fasciculations*</th>
<th>After cessation of fasciculations†</th>
<th>During straining</th>
<th>Degree of fasciculations</th>
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</table>

* Or first minute after injection when fasciculations were absent.
† Or second minute after injection when fasciculations were absent.

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### RESULTS

All individual data are presented in table I. Before the injection of suxamethonium the mean intragastric pressure was 13.8 cm H$_2$O (range 3–25). During fasciculations, or first minute after injection, the mean maximum pressure was 11.3 cm H$_2$O (range 4.5–25). After fasciculations had disappeared, or second minute after injection, the intragastric pressure was 9.6 cm H$_2$O (range 3–17).
Coughing and straining resulted in a significant rise in intragastric pressure to levels between 28 and 82 cm H$_2$O. In 8 of the 10 patients tested, intragastric pressures higher than 40 cm H$_2$O were obtained. Figures 3 and 4 show the effects of suxamethonium injection and that of straining of the intragastric pressure, respectively in two typical cases.

**DISCUSSION**

The resting intragastric pressure in paediatric patients following induction of anaesthesia seems to be slightly higher than the previously reported values in anaesthetized adult patients. The mean intragastric pressure in Roe's data (1962) was 11.9 (range 4-16) while in La Cour's patients (1969) the mean intragastric pressure was 7 cm H$_2$O (range 0-17). Two of our patients had resting intragastric pressures higher than 19 cm H$_2$O. The difference may be related to encroachment of some abdominal organs on the stomach, strenuous diaphragmatic breathing, and air swallowing during crying prior to induction.

From the present investigation, it is evident that the intravenous injection of suxamethonium in infants and children did not result in any appreciable rise in intragastric pressure. Indeed, the pressure was most frequently reduced. This is in contradiction with most other studies performed on adult patients. In his preliminary report on 10 patients, Andersen (1962) found that 3 exhibited marked increase in intragastric pressure due to intense fasciculations. Roe also found that in 3 of 25 patients, rises above 19 cm H$_2$O were encountered. Although Spence, Moir and Finlay (1967) did not find any significant rise in intragastric pressure in
20 patients, their method had been criticized since they used an open tube and not a balloon mounted on a catheter (La Cour, 1969). It is possible that the mucosa may occlude the openings when a sudden rise in pressure occurs. Miller and Way (1971), however, reported more frequent instances of markedly elevated intragastric pressure during suxamethonium fasciculations than other investigators. They attributed their findings to the fact that their patients were unpremedicated muscular young men.

The lack of rise in intragastric pressure in paediatric patients following the injection of a depolarizing muscle relaxant seems to be related to the absence of strong muscle fasciculations. In most of our patients, the fasciculations were absent or minimal, especially in infants and young children. Even in older children the fasciculations were too incoordinate to produce a significant rise in intra-abdominal and intragastric pressure. The fall in intragastric pressure is apparently due to the fall in intra-abdominal pressure with the onset of relaxation of the diaphragm and abdominal muscles.

It has been suggested that small infants may respond to depolarizing muscle relaxants like patients with myasthenia gravis (Rees, 1959). In both, the classical signs of a depolarization block are not usually observed. Instead, there are the typical features of a dual block including the rare occurrence of fasciculations (Rees, 1959; Churchill-Davidson and Wise, 1963).

Although prior administration of vagolytic drugs, such as hyoscine, may partly inhibit the increase in intragastric pressure associated with suxamethonium (Greenan, 1961), it is unlikely that this has contributed to the lack of rise in intragastric pressure in our patients. In one study on adult patients the increase in intragastric pressure in those premedicated with atropine was not statistically different from those in unpremedicated patients (Miller and Way, 1971).

Based upon data derived from adult patients, prior administration of an antidepolarizing muscle relaxant, such as tubocurarine, had been recommended (La Cour, 1970; Miller and Way, 1971). This prevents the fasciculations and the concomitant rise in intragastric pressure, but may replace it with an even more serious hazard: namely, antagonism of the depolarization block of suxamethonium (Bush and Baraka, 1964). Failure to achieve complete relaxation of the abdominal muscles and diaphragm may not prevent active vomiting (Wylie, 1963; Salem, 1970). Straining and coughing may also occur at the time of intubation and may lead to an abrupt rise in intragastric pressure more than that expected from suxamethonium. Because of the absence of intragastric pressure rise and because of the antagonistic actions between depolarization and antidepolarization types of block, prior administration of tubocurarine before suxamethonium is unnecessary in paediatric patients.
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This monograph is therefore welcome in that it sets
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Great credit for the recognition of toxic tracheal trauma
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Verabreichung von Tubocurarin bei pädiatrischen
Patienten mit "vollem Magen" vor einer Operation nicht
notwendig.

EFECTO DEL SUXAMETONIO SOBRE LA
PRESIÓN INTRAGASTRICA EN
INFANTES Y NIÑOS

RESUMEN
El efecto de la administración intravenosa de suxametonio
sobre la presión intragástrica fue investigado en treinta
pacientes pediátricos después de la inducción de anestesia.
En la mayoría de los pacientes hubo un descenso, mientras
que en cinco de los niños mayores ocurrió una ligera
elevación; el máximo fue de 4 cm H2O. Esto parece estar
relacionado con la ausencia de fuertes fasiculaciones
musculares, especialmente en niños y niños menores. La
administración anterior de tubocurarin no es necesaria
en pacientes pediátricos con "estómago lleno" a causa de
la falta de aumento de la presión intragástrica y a causa
de las acciones antagonistas de los tipos despolarizante
y antidespolarizante de bloqueo.

BOOK REVIEW

Prolonged Tracheal Intubation. Edited by John B. Stetson.
Published by Little, Brown and Co., Boston,
International Anesthesiology Clinics, Winter 1970,
Vol. 8, No. 4; pp. 224; indexed.

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