Aspiration of gastric contents and difficulty with tracheal intubation continue to be major causes of anaesthetic-related maternal mortality (Department of Health and Social Security, 1982). Laryngoscopy, or intubation, in a patient who is not deeply anaesthetized or in whom neuromuscular blockade is inadequate may provoke vomiting or the regurgitation of gastric contents (Gregory, 1979). Ideal conditions for intubation in patients who may have a significant volume of stomach contents, and who have been anaesthetized with a "sleep dose" of an induction agent are dependent on complete neuromuscular blockade (Donlon, Ali and Savarese, 1974). Laryngoscopy may precipitate forceful contractions of abdominal muscles and diaphragm. The degree to which this ideal was achieved in normal clinical practice was studied in patients who required anaesthesia for Caesarean section or for emergency general surgery.

PATIENTS AND METHODS
Twenty consecutive patients presenting for emergency Caesarean section were studied. They had a mean age of 26.2 yr (SEM 4.1) with a mean weight of 64.9 kg (SEM 3.4). In addition, a group of patients undergoing emergency general surgery were studied. They included 16 women and 7 men with a mean age of 42.7 yr (SEM 4.0) and a mean weight of 67.2 kg (SEM 2.5).

One investigator observed and recorded the normal clinical practice followed at induction of anaesthesia. It was considered appropriate to perform endotracheal intubation with special regard to the prevention of aspiration of stomach contents in all of these patients.

Patients in both groups were premedicated with magnesium trisilicate B.P.C. They were preoxygenated for 5 min, and a 10° left lateral tilt was used in all the pregnant patients. Cricoid pressure was applied before the commencement of the administration of the thiopentone.

A standard dose of suxamethonium chloride 1.5 mg kg\(^{-1}\) was injected to a fast flowing infusion via a 17-gauge cannula inserted to a forearm vein. The intubations were performed by eight junior anaesthetists of at least 1 year’s experience. Laryngoscopy was attempted when judged to be indicated clinically—when the patient’s jaw appeared relaxed and no fasciculations were

SUMMARY
The relationship between the time of onset of neuromuscular blockade and the time at which laryngoscopy was attempted was studied in patients presenting for emergency obstetric or emergency general surgical procedures. "Train-of-four" stimulation and visual observation of the evoked twitch response in the hand were used as a measure of the degree of neuromuscular blockade. The attendant anaesthetist was unaware of the response to the peripheral nerve stimulator. Intubation preceded complete neuromuscular blockade; in the obstetric patients there was no correlation between the two times. The use of a peripheral nerve stimulator should allow the anaesthetist to perform intubation in emergency situations with a greater degree of safety.
Table I. Mean times (SEM) for onset and duration of neuromuscular blockade and time to attempted laryngoscopy. * P < 0.01; ** P < 0.001

<table>
<thead>
<tr>
<th></th>
<th>Obstetric group</th>
<th>General surgical group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onset (s)</td>
<td>54.5 (7.4)*</td>
<td>81.8 (7.1)*</td>
</tr>
<tr>
<td>Duration (s)</td>
<td>354 (19.9)*</td>
<td>251 (24.8)*</td>
</tr>
<tr>
<td>Laryngoscopy (s)</td>
<td>29.8 (2.4)**</td>
<td>63.5 (4.5)**</td>
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observed. The airtight fit of the anaesthetic mask was maintained until laryngoscopy. Anaesthesia was continued with a 50:50 mixture of oxygen and nitrous oxide supplemented by 0.5% halothane.

A modified Wakeling Instruments peripheral nerve stimulator was used to deliver trains of four supramaximal stimuli every 10 s over the ulnar nerve at the wrist. The onset of full neuromuscular blockrade was considered to be the time when the evoked twitches of the thumb were no longer visible. The duration of neuromuscular blockade was taken as the time from the onset of blockade until the return of the first visible twitch.

Those administering the anaesthetic were unaware of the responses to the nerve stimulator as the patient's hand was screened. They were asked to administer the non-depolarizing neuromuscular blocker when they observed return of muscle tone.

A sample of blood was taken for estimation of pseudocholinesterase activity if the duration of neuromuscular blockade measured by the observer was more than 10 min.

RESULTS

Tracheal intubation in the majority of patients in both groups preceded the onset of neuromuscular blockade. In no patient was the trachea considered by the attendant anaesthetist to have been difficult to intubate. Details of the observations made at induction are given in table I. In the general surgical patients, a significant correlation was found between the onset of neuromuscular blockade and the time to intubation (P < 0.01). The correlation coefficient was 0.59 (fig. 1).

In the obstetric group, intubation was attempted considerably earlier in relation to the observed onset of neuromuscular blockade than in the general surgical patients. There was no significant relationship between the time to the onset of blockade and the time to laryngoscopy in the obstetric patients (correlation coefficient = 0.33) (fig. 2).

One of the patients undergoing Caesarean
Fig. 2. Time to attempted laryngoscopy plotted against time to complete neuromuscular blockade for the obstetric group. Points plotted to the right of the line correspond to intubation having been attempted before the onset of complete neuromuscular blockade.

section remained blocked for 1320 s and was later shown to be heterozygote for the atypical gene. Her results were excluded from the study.

The attendant anaesthetist observed signs of a return of muscle tone in the muscles of the head and neck in five patients before the evoked twitches were visible in the hand. In all of these patients, however, the response to the train of four stimuli was visible within the subsequent 60 s. The remainder of the patients had periods of up to 15 min before the attendant anaesthetist was aware that the evoked response had returned.

DISCUSSION

The study observed the normal clinical practice of junior anaesthetic staff responsible for the management of emergency obstetric and emergency general surgical patients. These two groups, although not directly comparable, represent the main categories in which aspiration of stomach contents is a major risk.

In the report on anaesthetic deaths, those caused by inhalation of stomach contents were associated frequently with difficulty in intubation (Department of Health and Social Security, 1982). Ease of intubation is dependent on several factors: the depth of anaesthesia, the degree of neuromuscular blockade, the skill of the anaesthetist and the anatomical configuration of the patient (Blackburn and Morgan, 1978).

Although intubation can be performed under deep inhalation anaesthesia, this is inappropriate in normal obstetric practice.

Intubation is performed commonly using an adequate dose of suxamethonium to provide profound neuromuscular blockade. The mean dose of suxamethonium used in our patients was approximately 100 mg and is the dose recommended by several authors (Crawford, 1978; Moir, 1980). In such a technique, ideal conditions for intubation are achieved when the twitch height of the adductor pollicis is depressed by more than 95% from its baseline value (Donlon, Ali and Savarese, 1974).

It is recommended that, in the obstetric patient, tracheal intubation should take place when the jaw is relaxed (Moir, 1980). Speed of intubation in obstetric anaesthesia has been stated to be essential (Doughty, 1979). These recommendations may encourage early and inappropriate intubation attempts. Attempts at tracheal intubation in a patient in whom neuromuscular blockade is incomplete may provoke regurgitation or active vomiting. Coughing on intubation, in the patient with a full stomach, produces marked increases in intragastric pressure (Spence, Moir and Finlay, 1967; Lacour, 1970) as well as the subsequent aspiration of gastric contents (Snow and Nunn, 1959).

The clinical estimation of neuromuscular blockade, as judged by the time to laryngoscopy, did not correlate with the measured degree of blockade in the obstetric group. The poor clinical assessment...
EMERGENCY INTUBATION: SUXAMETHONIUM

of adequate blockade could be caused by reluctance to wait, or it could be that complete blockade is difficult to judge clinically. The onset of blockade in the obstetric patients was quicker than in the general surgical group. This may reflect the greater cardiac output of full-term pregnant women. The duration of blockade was also significantly longer in the pregnant women and this may be caused by reduced pseudocholinesterase activity (Hazel and Monier, 1971).

Our results are similar to the values for the action of suxamethonium obtained by other workers, who used strain gauges and recording devices to assess the mechanical response of the thenar muscles to stimulation of the ulnar nerve (Katz et al., 1969; Blitt et al., 1981). Stimulation of the hand muscles does not provide an exact simultaneous measure of the degree of neuromuscular blockade present in the diaphragm or abdominal muscles. The administration of suxamethonium causes a sequential onset of muscle fasciculation throughout the body with the extremities seen to fasciculate last. The return of muscle tone seen in the head and neck muscles of a minority of our patients before return in the hand, may be an expression of the converse recovery sequence. The hand, by its peripheral situation, may be a more accurate comparison for the abdominal muscles than the muscles of the head.

The peripheral nerve stimulator is an established aid to the management of neuromuscular blockade and its use should result in safer and more efficient intubation in emergency situations.

REFERENCES