The induction of anaesthesia in the foot-down position for patients with a full stomach

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The inhalation of gastric contents is probably the most common cause of death during anaesthesia. With the introduction of the intravenous barbiturates and the relaxants, the problem has become more acute since, with these agents, gastric contents may reach the larynx when the protective reflexes are in abeyance.

We have confirmed the experience of Weiss (1950) and Culver, Makel and Beecher (1951) that, in some 25 per cent of patients, gastric contents may reach the pharynx during the course of an anaesthetic. However, the danger of aspiration under these circumstances may be avoided by intubation with a cuffed endotracheal tube and the major problem with which this paper is concerned is aspiration during induction.

METHODS OF PREVENTION OF ASPIRATION

Avoidance of general anaesthesia.

This has been our method of choice when it is applicable. We have made extensive use of regional blocks in the case of trauma to limbs. Pudendal block has greatly reduced the number of general anaesthetics given for forceps delivery.

Emptying the stomach pre-operatively.

This would appear to be both the logical and the safest method of preventing the aspiration of stomach contents. Unfortunately there are certain disadvantages and it may not be possible to be certain that the stomach is in fact satisfactorily emptied. Edwards et al. (1956) refer to nineteen cases in which attempts to empty the stomach were followed by fatal aspiration during induction. Not only are there technical difficulties in emptying the stomach, but it is possible for the stomach to refill from the duodenum before induction is carried out.

Under certain circumstances, such as foetal distress, there may not be time to empty the stomach. Also, with some hesitation, we would mention as a disadvantage, the passage of a wide-bore tube on a severely ill patient. If it is life-saving then clearly it is essential, but those who are conversant with the procedure will be prompted to enquire whether any other method will confer an equal degree of safety.

Our major objection to relying upon the pre-operative emptying of the stomach is the very large number of patients who are at risk. In this respect the experience of individuals varies according to the types of cases they are called upon to anaesthetize. But, to the resident anaesthetist at a general hospital with a large emergency intake it quickly becomes apparent that the problem of aspiration is not confined to "emergency abdomens" and obstetrics. Safety can only be achieved by the routine emptying of stomachs on a large scale.

Preservation of the laryngeal reflex during induction and intubation.

One of the principal advantages of induction of anaesthesia with inhalational agents, such as ether, is that, should vomiting occur, the laryngeal reflex will normally be present and there should be no aspiration. The airway is thus protected primarily by the patient rather than the anaesthetist and this is advantageous should the latter be inexperienced. Nevertheless, in a seriously ill patient the laryngeal reflexes are less active than normal and vomiting may well be dangerous during an induction with inhalational agents.

Blocking of the cardia or oesophagus.

From time to time, techniques are described in which balloons, packs or tubes are passed into the oesophagus with a view to preventing or diverting the reflux of gastric contents. We have not used these techniques since we thought that too much depended upon the accurate positioning of such a blocker. No report has been made of the safety of these techniques in a large series.
Induction in the Trendelenburg or lateral position.

The suggestion is often made that induction should be carried out in a position which will cause regurgitated gastric contents to drain away from the pharynx before aspiration can occur. So far as we are aware, no-one has shown this to be unsafe but, nevertheless, it would appear to be preferable to employ a technique which prevents regurgitation rather than one which merely renders it innocuous.

Intubation or tracheostomy before the induction of anaesthesia.

If there is no direct access to the larynx and if there is any possibility of vomiting or regurgitation then preliminary intubation is essential. We have carried out this procedure in cases of severe facial injuries.

Rapid induction and paralysis in the foot-down position.

Morton and Wylie (1951) suggested that a foot-down tilt of at least 20° might be effective in preventing regurgitation following the exhibition of thiopentone and a full dose of a muscle relaxant. They stressed the possible undesirable circulatory effects of the combination of position and thiopentone and considered it a technique suitable only for fit patients and experienced anaesthetists. Scurr (1958) goes further and suggests that the upright position should be adopted. Although the technique has probably been used widely, only the recent work of Hodges et al. (1959) has testified to its safety. Many are reluctant to adopt a technique which is not supported by a considerable body of evidence and it is for that reason that this paper is presented.

THE ACTION OF THE CARDIA

It is now generally agreed that the prevention of regurgitation is not due to any pinchcock action of the crura (Braasch and Ellis, 1956) and that the cardiac “sphincter” is of little if any importance. Thus, O’Mullane (1954) showed that the cardia resisted reflux if the patient was curarized, if the sympathetic ganglia were paralyzed and finally if the region of the cardia was painted with amethocaine. Perhaps the most convincing evidence against these mechanisms is the finding of Marchand (1954) that the cardia is competent in the cadaver.

It is now thought by many that the essential mechanism is that of a valve (O’Mullane, 1954; Dornhorst, Harrison and Pierce, 1954). It is, however, difficult to reconcile this mechanical theory with the dramatic regurgitation of gastric contents which may follow the induction of anaesthesia with intravenous agents. There are two possible explanations of this discrepancy.

Dornhorst and his co-workers (1954) showed that during Muller’s manoeuvre a pressure differential of 80 mm Hg might exist between stomach and oesophagus. It is conceivable that during induction with thiopentone and a relaxant there might be a short period of time when the tongue had fallen back to obstruct the airway although respiration was still present. Under these conditions it is possible that a pressure differential would develop across the cardia which would be sufficient to force the “valve”.

The second possible explanation is that patients who regurgitate during induction of anaesthesia have already an incompetent cardia beforehand (Dinnick, 1957). These patients would normally rely upon the striped muscle of the upper part of the oesophagus for protection of the larynx and this protection would be abolished by the use of a relaxant (Sinclair, 1959). Striking confirmation of this theory has been obtained by Dinnick (personal communication) who followed up five patients who regurgitated during induction and in each case found an incompetent cardia at postoperative barium meal. Further support is lent to this theory by the fact that many patients do not regurgitate during induction but are subsequently found to have a full stomach.

Of the greatest interest were O’Mullane’s observations of the intragastric pressure. He found the normal pressure to be of the order of 5 cm water and even with distension of the abdomen it did not rise above 18 cm water unless there was contraction of the abdominal wall. The intragastric pressure was found to fall when patients were tilted foot-down.

It would, therefore, appear that induction with thiopentone and a relaxant would be safe provided two conditions were fulfilled:

1. That the abdominal muscles did not contract.
(2) That the larynx was maintained at a height (in centimetres) above the cardia greater than the intragastric pressure (in centimetres of water).

If anaesthesia is rapidly induced with thiopentone and a suitable relaxant, contraction of the abdominal muscles at any stage is very unusual. The second requirement may be met by the appropriate foot-down tilt of the table.

<table>
<thead>
<tr>
<th>Degrees of tilt</th>
<th>Height of larynx above cardia (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>12.5</td>
</tr>
<tr>
<td>30</td>
<td>16</td>
</tr>
<tr>
<td>40</td>
<td>19</td>
</tr>
</tbody>
</table>

(These figures are based on a larynx-cardia distance of 25 cm and a 10° inclination of this line to the vertical axis of the body. They are not applicable to children.)

TECHNIQUE

No attempt need be made to empty the stomach unless there is distension, in which case the intragastric pressure should be reduced by aspiration. A Ryle's tube is usually sufficient for this purpose.

Anaesthesia is induced on the table in the operating theatre. The table should be equipped to prevent the patient sliding off it at steep angles of tilt.

The anaesthetic equipment and sucker should be carefully checked before induction as the technique allows no time for the replacement of missing or defective apparatus. We believe that a sterile bronchoscope should be available in every theatre which handles emergency surgery.

The body of the patient should be placed in a steep foot-down tilt in either of the positions shown in the figure. Additional height may be obtained by having two pillows under the head and shoulders.

An adequate dose of thiopentone (150–300 mg) is injected. This is followed (or accompanied) by gallamine (80–160 mg). Gallamine is preferred to tubocurarine because of its more rapid action and to suxamethonium because it is feared that the depolarization of the abdominal muscles might raise the intragastric pressure. We are not convinced that, in large doses, the action of gallamine is appreciably slower in onset than that of suxamethonium. During or before induction 100 per cent oxygen is administered with a face mask.

After injecting thiopentone and gallamine, the anaesthetist takes station at the head of the patient—standing on a stool if necessary. As consciousness is lost the lungs are inflated with oxygen and as relaxation becomes complete the endotracheal tube is introduced. The cuff is then inflated, the table levelled and the patient ventilated with a nitrous oxide-oxygen mixture.

During the course of the operation, the stomach may be emptied through a wide-bore tube which is passed at leisure.

With the technique as described, it is unusual for the patient to be exposed to the combination.

**FIG. 1**

Alternative positions in which the patient is tilted to an angle of 40° to the horizontal, thus raising the larynx approximately 20 cm above the level of the cardia.
of thiopentone anaesthesia and the foot-down tilt for more than 60 seconds. It is unlikely that hypotension during this period would be harmful.

A serious situation develops if the anaesthetist is unable to introduce an endotracheal tube into a paralyzed patient with a full stomach in the foot-down position. In the last five years we have encountered only one patient whom we failed to intubate. She had multiple deformities due to congenital syphilis and would not have been considered a suitable candidate for the technique here described.

**CONTRA-INDICATIONS**

There appear to us to be only two contra-indications to the use of this method, provided always that the anaesthetist is sufficiently competent to undertake anaesthesia at all for these cases. These are:

1. Absence of a suitable operating table and other equipment.
2. Deformity or injury which might render intubation difficult.

It is worthy of note that the “dystrophic” type of patient, so frequently seen at Caesarean section, may be difficult to intubate on account of the short neck associated with the condition.

**RESULTS**

The technique as described has been used by us for five years. Table I indicates the groups of patients so anaesthetized.

**Table I**

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caesarean section (including emergency)</td>
<td>480</td>
</tr>
<tr>
<td>Intestinal obstruction</td>
<td>46</td>
</tr>
<tr>
<td>Perforated peptic ulcer</td>
<td>19</td>
</tr>
<tr>
<td>Emergency gastrectomy for haemorrhage</td>
<td>31</td>
</tr>
<tr>
<td>Emergency laparotomy for conditions not found to be amenable to surgical treatment</td>
<td>12</td>
</tr>
<tr>
<td>Trauma to abdomen and face</td>
<td>8</td>
</tr>
<tr>
<td>Femoral embolectomy</td>
<td>1</td>
</tr>
<tr>
<td>Twisted ovarian cyst</td>
<td>3</td>
</tr>
<tr>
<td>Drainage of intra-abdominal sepsis</td>
<td>5</td>
</tr>
<tr>
<td>Ectopic gestation</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>606</strong></td>
</tr>
</tbody>
</table>

All cases of Caesarean section are included in one group as the risk of aspiration is not precluded by the customary period of starvation before elective operation. No cases of forceps delivery are included as these patients were not delivered on operating tables and tilting was not practicable.

Among the patients listed in table I there was only one instance of regurgitation. This occurred in a patient in whom the dose of relaxant had been badly underestimated. As the tube entered the larynx an explosive cough forced a large quantity of liquid stomach contents into the pharynx. No aspiration occurred. Lest it should be imagined that the authors are less than normally accident prone we append (table II) a list of the patients anaesthetized by us who have regurgitated and inhaled gastric contents. In these cases anaesthesia was induced with thiopentone and relaxants in the supine position, since the risk of aspiration was not appreciated.

**Table II**

<table>
<thead>
<tr>
<th>Year</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1952</td>
<td>Stab wound of liver (J.F.N.)</td>
</tr>
<tr>
<td>1954</td>
<td>Laparotomy on a diabetic patient (oral glucose) (J.F.N.)</td>
</tr>
<tr>
<td>1954</td>
<td>Caesarean section (J.F.N.)</td>
</tr>
<tr>
<td>1955</td>
<td>Severe burns (J.F.N.)</td>
</tr>
<tr>
<td>1955</td>
<td>Cystoscopy for clot retention (R.G.S.)</td>
</tr>
<tr>
<td>1955</td>
<td>Emergency prostatectomy (R.G.S.)</td>
</tr>
</tbody>
</table>

There was no clinical evidence that any patient suffered from circulatory disturbance although it was not practicable to measure the blood pressure during the period of induction. In two cases (J.F.N.) it was deemed prudent to omit the thiopentone and induce anaesthesia with cyclopropane, but it is appreciated that the use of an inhalational agent increases the hazard of vomiting.

There was no instance of failure to intubate in this series. Some difficulty was experienced with one patient who was of a pronounced “dystrophic” type. The endotracheal tube was usually passed at the first attempt.

In the Caesarean sections the time from induction of anaesthesia to delivery varied from 15 to 25 minutes. There was no evidence of foetal depression and in this respect we are in agreement with the results of Hodges et al. (1959). It was not to be expected that the dose of thiopentone used would result in a high foetal blood level after 15 minutes (Crawford, 1956). It was, however, of interest that in no case was there any suggestion of foetal myoneural block, although at the time of delivery many of the
mothers were still apnoeic. It is not easy to reconcile this finding with the view that gallamine crosses the placental barrier (Crawford, 1956).

No patient raised any objection to being anaesthetized in the operating theatre rather than in the anaesthetic room. Most patients were more concerned with their condition than with their environment and their attitude differed from that of patients admitted for planned surgery.

COMMENTS

Our results suggest that rapid induction of anaesthesia and paralysis in the foot-down position confers a high degree of protection from the aspiration of gastric contents. It does not appear to carry any obvious hazard from hypotension.

The technique is not difficult and causes only minimal delay and inconvenience to patient and staff. Therefore, it can be widely applied to cover all patients who are even remotely at risk. Table II indicates how widely the net of stomach emptying would have to be cast to achieve security.

Failure to omit any detail from the technique is fraught with danger and herein lies the principal objection to the method. Thus, a faulty laryngoscope, a leaking cuff, or failure to intubate, would all constitute a grave hazard. We would stress that this is not a technique for the tyro and it is difficult to exaggerate the importance of checking apparatus and equipment before induction.

We refrain from suggesting which might be the best method for anaesthetizing patients with full stomachs. The choice must depend upon a number of factors, many of which lie outside our experience. We would, however, maintain that, in our hands, the technique suggested by Morton and Wylie (1951) has been found to be satisfactory and safe.

SUMMARY

The problem of anaesthetizing patients with full stomachs is considered.

A technique of rapid induction in the foot-down position is described. This is essentially the method suggested by Morton and Wylie (1951).

We have used the technique for five years in a total of 606 patients considered to be at risk. In no case have we encountered aspiration of gastric contents.

ACKNOWLEDGMENTS

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REFERENCES


