THE USE OF d-TUBOCURARINE CHLORIDE FOR CAESAREAN SECTION—A REPORT OF 210 CASES

By H. T. Davenport

The object of this paper is to examine the results of a certain form of anaesthesia used for 210 consecutive Caesarean operations during one year. A statistical review has been published elsewhere of a larger series to indicate the broad outcome of this and some other methods (Davenport and Prime, 1950).

The use of one anaesthetic technique by one anaesthetist in the same hospital over a short period has reduced the variables in such a survey.

TECHNIQUE

Premedication consisted of 0.6 mg. atropine given intramuscularly 30 minutes before the operation, or intravenously in case of emergency.

The patient was placed upon the operating table and the abdomen prepared by the surgeon who then stood “knife in hand”. To facilitate venipuncture both arms were extended on supports attached to the table. A test dose of 5 mg. d-tubocurarine chloride (Tubarine) was given and the patient observed for a short period for undue reactions, after which an estimated addition of d-tubocurarine chloride was given. Immediately following this, sleep was induced with 10 per cent thiopentone.
d-Tubocurarine Chloride for Cæsarean Section

(Kemithal) and maintained with cyclopropane given by a closed carbon dioxide absorption system with which respiration could be aided manually if necessary (Gray, 1947).

The incision was made as soon as the eyelash reflex was abolished and 0.5 or 1 mg. ergometrine was given intravenously as the head of the child was about to be delivered. A post-operative analgesic, morphine or Omnopon, was given before the patient returned to the ward, together with the antidote (neostigmine) for any depressed upper intercostal muscle activity.

The average dose of d-tubocurarine chloride required was 15 mg., ranging from 8 mg. to 20 mg., and of thialpentone an average of 0.4 g. was needed to induce sleep, the range being 0.3 g. to 0.7 g. On eight occasions a second dose of thialpentone was employed after delivery to gain more depth as and when needed.

During the latter stages of some operations trichlorethylene was administered by the semi-closed method, with the object of retaining some analgesia for a period until the post-operative sedation took effect. This was found effective owing to the slow elimination of this agent.

THE MATERIAL

There had been no selection of cases and the indications for operation given by the obstetrician were as follows. It is apparent that in the majority of cases there was a combination of factors.

(Throughout this paper infant deaths are shown by asterisks (*) at the appropriate places.)
Eighty (38 per cent) of these cases were emergency sections and their preparation was limited. This indicates the probability of a full stomach and nervous distress or tension in these patients.

The mothers were also divided into two classes, (a) those having general disorders which would be considered detrimental to performing an operation, and (b) those who would be considered fit for any such procedure (Heard, 1946).

<table>
<thead>
<tr>
<th>Emergency labouring</th>
<th>Elective</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Abnormal</td>
<td>37*</td>
<td>48*</td>
</tr>
<tr>
<td>(b) Normal</td>
<td>43*</td>
<td>82**</td>
</tr>
<tr>
<td>Total</td>
<td>80</td>
<td>130</td>
</tr>
</tbody>
</table>

A transverse lower segment operation was performed through a midline sub-umbilical incision in the majority
of cases. The exceptions were 7 transverse Pfansteil's approaches, 2 classical operations and 1 Porro hysterectomy. In four instances a ventral hernia was repaired and in twenty-three sterilization was performed at the time of the operation.

The distribution of patients according to age. Number of patients 210
When the operation began there was evidence of a living foetus in all except one case. In every operation a living child was delivered which was viable by maturity standards, i.e. apparently beyond the 28th week of development.

The average age of the patients was 32 years, with a range of 16–45 years (fig. 1).

ANALYSIS OF MATERNAL RESULTS

(a) Operative incidents

The average duration of this operation was 39 minutes, with a minimum of 20 minutes and a maximum of 135 minutes (fig. 2).
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The average time for delivery of the foetal head was 7½ minutes, with a range of 2-17 minutes (fig. 3).

The technique was not thought to necessitate undue hurry and in many repeat operations old scar tissue was excised at the beginning of the operation. On no occasion was it necessary to change the technique owing to inability to perform a venipuncture, but once it was necessary to finish the induction by the inhalation method owing to the dislodgement of the needle.

Two patients became distressed after the initial dose of d-tubocurarine chloride, which had acted rapidly and

![Graph showing time taken in minutes from induction of anaesthesia to delivery of the foetal head.](https://example.com/graph.png)

**FIG. 3**
Length of time from induction of anaesthesia to delivery of the foetal head.
markedly, but immediate intravenous induction of sleep abolished any memory of this discomfort.

A natural airway was maintained whenever possible as it was recognized that the introduction of a pharyngeal airway would increase the likelihood of vomiting and laryngospasm. It was found that when conditions necessitated aided respiration, gas could sometimes pass into the stomach. This amounted to considerable quantities on two occasions, one patient needed a stomach tube inserting, but neither showed adverse effect later.

On fourteen (6.5 per cent) occasions endotracheal tubes were inserted, of which seven may be termed prophylactic, as indicated by the following reasons:

Case 1. Short thick neck—no atropine.
Case 2. Severe heart disease.
Case 3. Excessive secretion necessitating bronchial aspiration.
Case 4. Short thick neck.
Case 5. Short thick neck.
Case 6. Marked muscular flaccidity liable to lead to airway obstruction.
Case 7. Intended hysterectomy.

The remainder may be considered accidents requiring this artificial airway as treatment.
Case 8. Laryngospasm—? minor regurgitation stimuli.
Case 10. Cyanosis with difficulty in inflation—? bronchospasm.
Case 11. Cyanosis with difficulty in inflation—? bronchospasm.
Case 12. Stridor with some cyanosis in a patient with heart disease.

Case 13. Immediate gastric regurgitation.


It was found that curarization made it easy to correct such incidents provided the necessary apparatus, e.g. suction, was always available.

The pulse pressure and rate were found in many patients to return to normal upon induction, although they were, in a large proportion of the unsedated subjects, greatly elevated pre-operatively.

Severe hypotension occurred rarely and each time there was relevant hemorrhage or hypoxia. None of the agents the anæsthetist used was associated with the drop in blood pressure.

Uterine blood loss generally was not great as retraction was good—any large low cervical vein needing control was easily accessible immediately after delivery.

Relaxation was always to the surgeon's satisfaction and the bowel did not intrude upon the wound, although peritoneal packing was not a practice of any of the surgeons.

Cardiac arrhythmia was rare, possibly because no more than 25 per cent by volume of cyclopropane was needed as plane 1 was always considered adequate depth of anæsthesia. On the four occasions in which extrasystoles or tachycardia was detected ether was substituted for the cyclopropane with the desired result.

As seen from the intubation records, during the course of the anæsthetic laryngospasm occurred on three
occasions, and what was considered as possible broncho-
spasm occurred twice.

Four patients vomited copiously after operation, but all
had active pharyngeal and laryngeal reflexes and they did
not apparently aspirate any stomach contents.

Intravenous neostigmine, together with atropine (usually
a combination of 5 mg. and 1.2 mg. respectively) was given
to counteract the residual upper intercostal inactivity in
51 (24.5 per cent) patients in whom the operation had been
completed within 25 minutes. No ill-effects were observed
from this measure and deeper respiratory excursions
always followed the injection.

(b) Post-operative sequelae

The relation between the pre-operative and post-
operative states is of great importance, but with emergency
obstetric cases it is often impracticable to obtain a careful
pre-operative assessment. Such difficulty prevailed in
nearly 50 per cent of the cases reviewed here. Post-
operative conditions are, therefore, merely enumerated.

The respiratory system was affected in 26 (12.5 per cent)
patients. Thirteen had cough as the only evidence of
disease, 7 produced sputum and their condition was
diagnosed as bronchitis, 5 gave definite clinical signs of
atelectasis and there was a single case of dyspnoea with
cyanosis of one day duration, the cause of which was not
diagnosed.

Discomfort due to abdominal distension was complained
of by seven patients; all were cured by simple remedies.

Urinary disorders, all of which improved from the time
of delivery, were in most instances attributable to the
obstetric condition. Immediate post-operative retention
necessitated catheterization on four occasions.
Wound infection, generally with haematoma formation, was found in nine instances, one leading to some disruption of the incision line, necessitating resuture.

Thrombosis of venous channels was found in eight patients, twice of considerable severity in the leg and once in the arm region when ergometrine had been injected into the subcutaneous tissue. Two patients developed signs of ketosis and one of hypoglycaemia.

Miscellaneous conditions were found in single cases but were not related to the anaesthetic except possibly one of considerable vaginal bleeding within 24 hours of operation.

From the temperature charts it was found that 54 patients had some pyrexia, the rest being completely afebrile, and it is of interest that 44 women were given antibiotic drugs for some reason.

**Analysis of Infant Results**

There were 104 female and 108 male infants delivered, including two sets of twins, making a total of 212 infants.

The distribution of their weights was as in figure 4.

Thirteen of the infants delivered were immature, taking as a criterion of immaturity a birth weight of less than 5½ lb. (2.4 kg.).

The infants on delivery were taken by a nurse to the sterile cot where she undertook toilet of the pharynx by suction with a soft catheter. If the infant did not cry within 1 to 3 minutes a doctor undertook further treatment, such as repeated suction and oxygen administration through a Gibbert-Blakeley bag, with which intermittent pressure no greater than 20 cm. of water was applied. Alphalobeline was occasionally given into the cord veins.

More vigorous resuscitating measures were used when the infant reached the flaccid stage with pallor and
Fig. 4
Distribution in the infants' weights
d-Tubocurarine Chloride for Caesarean Section

decreased heart rate. They consisted of pharyngeal and tracheal toilet with direct vision, using a Shadwell laryngoscope, endotracheal intubation with size 00 Magill tube and further intermittent oxygen insufflation by direct connection to that tube. Oxygen tents on return to the ward were also used whenever it was deemed necessary. The number of times on which these measures were employed is tabulated below.

<table>
<thead>
<tr>
<th></th>
<th>Emergency (labouring)</th>
<th>Elective</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spontaneous respiration</td>
<td>49*</td>
<td>89*</td>
<td>138 (65 per cent)</td>
</tr>
<tr>
<td>Some resuscitation</td>
<td>26</td>
<td>35</td>
<td>61 (29 per cent)</td>
</tr>
<tr>
<td>Intubation</td>
<td>7*</td>
<td>6*</td>
<td>13 (6 per cent)</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>212</td>
</tr>
</tbody>
</table>

Three male and two female infants (2.5 per cent) did not survive the neonatal period.

In attempting to find some cause for the infant deaths certain factors have to be taken into consideration; first, the health of the mother, which clearly must be of importance in this connection; secondly, the viability, degree of maturity, the presence of congenital difficulty or disease of the foetus, as well as its presentation and position, are important, and thirdly, complications of labour and delivery must be considered. No direct correlation has been found between these factors and infant deaths in this series. Age and parity of the mother may, however, have been a factor as all those whose babies died were multiparæ and over 33 years of age. A critical view may indict certain points in the maternal history or infant's progress when a reason for death is being sought in an individual case.
<table>
<thead>
<tr>
<th>No.</th>
<th>Age</th>
<th>Parity</th>
<th>Pre-operative facts</th>
<th>Infant facts</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>35</td>
<td>2</td>
<td>Repeat operation.</td>
<td>Baby only gasped—cyanosed. Delayed intubation owing to defective apparatus.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No.</th>
<th>Age</th>
<th>Parity</th>
<th>Pre-operative facts</th>
<th>Infant facts</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>33</td>
<td>3</td>
<td>2 previous stillbirths. Elective operation refused. 58 hrs. ineffective labour. No F.H.H. for 2 days—then mother felt movements.</td>
<td>Baby flacid, much meconium in trachea. Intubated, only gasped, lungs well expanded at P.M.</td>
</tr>
</tbody>
</table>

An autopsy was performed on each of the five infants, the results being:

<table>
<thead>
<tr>
<th>No.</th>
<th>Age</th>
<th>Weight</th>
<th>P.M. diagnosis of cause of death</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10 hrs.</td>
<td>6 lb. 1 oz.</td>
<td>Bilateral lower lobe atelectasis.</td>
</tr>
<tr>
<td>2</td>
<td>72 hrs.</td>
<td>6 lb. 3 oz.</td>
<td>Atelectasis.</td>
</tr>
<tr>
<td>3</td>
<td>3 hrs.</td>
<td>4 lb. 11 oz.</td>
<td>Patchy atelectasis.</td>
</tr>
<tr>
<td>4</td>
<td>3 hrs.</td>
<td>5 lb. 13 oz.</td>
<td>Intraventricular hemorrhage.</td>
</tr>
<tr>
<td>5</td>
<td>24 hrs.</td>
<td>5 lb. 3 oz.</td>
<td>Cerebral asphyxia with atelectasis.</td>
</tr>
</tbody>
</table>

Apart from the special care necessary for the premature and Rh infants, all but the following progressed as if delivered normally with good feeding habits and increased weight at the end of the observed time.
Eight gave indications of chest disease.
Four had signs of cerebral anoxia.
Four had minor intestinal disorders which were easily cured.
Two had oedema and one jaundice, the cause of which was not determined.
Three had conjunctival infection.
Three had some signs of mongolism.

COMMENTS

In an attempt to examine this anaesthetic technique impartially the complete hospitalization of the mothers and infants was followed. The records produced may enable readers to compare this innovation with other methods similarly reviewed. Also the dangers will be apparent to those intending to try this method.

The curare sequence described was found pleasant and convenient for patients and surgeons and they often expressed a preference for it over other methods previously experienced—the wisdom of their choice needs to be proved. One patient had had difficulty in breathing and a choking feeling owing to full curarization with delay in the induction of sleep at her previous operation. She then developed an extreme terror that her next pregnancy should necessitate a repetition of this feature. This should be avoided in future.

To employ this complex sequence of drugs a specialist anaesthetist has been necessary and this seems to be the ideal aim for all operative deliveries. Perfect team work and preparation to deal with all complications was essential at all times. For this an extra doctor with knowledge of resuscitation should be present, preferably a paediatrician or an anaesthetist, who then supervises the infant's care.
for the next 24 hours, it being well recognized that the incidence of neonatal morbidity and mortality is greatest during this period.

Delay in institution of a resuscitation routine and subsequent care, e.g. respiratory tract toilet and oxygen therapy, may be disastrous. The decision of when to intervene and whether intensive efforts are justified by the state of the salvaged infant need further investigation.

SUMMARY

At Liverpool Maternity Hospital 210 patients underwent Caesarean section with curare as an adjuvant in their anaesthesia during 1949. The outcome has been studied.

There were no maternal deaths but five infants did not survive the neonatal period.

Some impressions are discussed which stress the advantage of closer co-operation of anaesthetist, obstetrician and paediatrician.

The author is indebted to the Staff of Liverpool Maternity Hospital for their co-operation and permission to publish this report.

REFERENCES