ANAESTHETIC PROBLEMS IN MYOTONIC DYSTROPHY

A Case Report and Review of the Aberdeen Experience Comprising 48 General Anaesthetics in a Further 16 Patients

L. M. ALDRIDGE

Myotonic dystrophy (dystrophia myotonica) is an autosomal dominant disease. It exhibits almost complete penetration but great variability of expression within affected families and notably between generations. It is the commonest dystrophy of adult life. Precise figures are few and those available are likely to be underestimates, as many cases fail to come to medical attention or are misdiagnosed. The figures from a number of centres indicate the prevalence of disease to be 2.4–5.5 per 100000 of the population. Only Duchenne dystrophy has a higher incidence at birth, although its prevalence is reduced by early mortality (Harper, 1979). While the muscles are affected primarily, myotonic dystrophy is a multi-system disease. The diagnosis may not be made until late in the disease and the presentation can therefore vary widely. Muscle pathophysiology consists of myopathy, myotonia or both. The histology of affected muscles is characteristic, with Type I fibre atrophy and Type II fibre hypertrophy being early features (Buxton, 1980; Anderson, 1985).

Typically, the patient has early facial weakness (expressionless face), wasting and weakness of the sternomastoids, ptosis, dysartria, progressive distal muscle weakness and wasting (proximal involvement predominates in most myopathies) with myotonia or inability to relax the grip. Other features found to a variable degree are frontal balding, cataract, testicular atrophy, low IQ and ECG conduction defects. Mild disease presenting later in life may be associated with few symptoms and show few of the distinguishing signs.

SUMMARY

A previously undiagnosed case of myotonic dystrophy presenting with apnoea of 2.5 h duration following thiopentone is described. A review of the anaesthetic outcome from 49 operations in 17 patients with myotonic dystrophy in the Aberdeen area is presented. The type of operation and intra- and postoperative problems are analysed. The results reveal a 52% complication rate in previously diagnosed cases and a 35% complication rate in undiagnosed cases. In the series, 29% of the anaesthetics were administered to symptomatic patients before formal diagnosis. To avoid potential hazards it behoves the anaesthetist to remain alert to the possibility of the undiagnosed disease. The symptomatology and associated findings of the 17 patients at initial diagnosis are presented. The literature has been reviewed and anaesthetic implications noted.

CASE REPORT

In November 1983 a 48-yr-old woman with menorrhagia and an iron deficiency anaemia (haemoglobin concentration 9.6 g dl⁻¹) presented for dilatation and curettage (D&C). Despite there being “no medical history of note”, perusal of notes established that in 1966 she had complained of stiffness and pain in arms and legs. No significant abnormality was detected and it was suggested that her symptoms were stress-induced, relating to a 20-week stillbirth delivered a few months previously. In 1968 a discrepancy was noted in the size of her calves; this was thought to have arisen from a previous subacute infection with poliomyelitis. In 1975 she experienced
increasing pain in her back and legs. Sciatica was postulated and a brace supplied. In 1979 she was noted to have increased right leg pain, wasting and power loss.

In addition, there was a history of seven general anaesthetics during the years 1956–1966; six of those were for EUA and D&C arising in connection with investigations of infertility and spontaneous abortions. The seventh was for the insertion of Shirodkar suture. In June 1970 she was delivered at 35/40 weeks of a healthy male child.

On preoperative examination in 1983 the patient complained of tiredness, and of dyspnoea after one flight of stairs. This appeared unremarkable in an obese (weight 65 kg, height 1.52 m), anaemic 48-yr-old woman who was an occasional light smoker. The patient’s arms and legs were disproportionally thin in relation to the obesity of her trunk, giving the impression of a Cushingoïd appearance. Enquiry established the absence of any previous steroid therapy. It was only at the time of anaesthetic, following induction, that the small muscle wasting of her hands and feet became apparent.

General anaesthetic

Following premedication with lorazepam 3 mg by mouth, anaesthesia was induced with thiopentone 350 mg and nitrous oxide and halothane in oxygen were administered via a face mask. Spontaneous ventilation was inadequate and was accompanied by abdominal movements suggestive of respiratory obstruction. A Guedel airway was inserted without any noticeable improvement.

Difficulty was experienced in ventilating the lungs adequately via the face mask and the Magill breathing system, resulting in the development of cyanosis and an increasing level of consciousness manifested by the patient attempting to speak. Increasing $F_{1O_2}$ to 50% effected little change and the trachea was readily intubated with an 8-mm cuffed oral tracheal tube following a further thiopentone 150 mg. Suxamethonium was avoided, as the severity of the respiratory depression in conjunction with her clinically apparent distal muscle wasting suggested the presence of neuromuscular disease. Following intubation, her lungs could be ventilated easily without evidence of obvious obstruction or bronchospasm. Her colour improved immediately, and she was maintained throughout the procedure on 66% nitrous oxide and 0.5% halothane in oxygen. Following termination of nitrous oxide and halothane, the patient failed to sustain adequate spontaneous ventilation, despite continued vigorous abdominal movements.

Several attempts were made to wean the patient from the ventilator, but on each occasion cyanosis developed as the result of an inadequate tidal volume of 50–75 ml (Wright respirometer). One-and-a-half hours after the induction with thiopentone she remained apnoeic and was transferred to the recovery ward, where ventilation with nitrous oxide and oxygen was continued via a Manley ventilator. Doxapram was given, with marginally beneficial effect. The tidal volumes increased gradually; eventually sustained spontaneous ventilation was evident, some 2.5 h after the administration of thiopentone.

The patient was transferred to the ITU where improvement continued and by 6.30 p.m. (4.5 h after thiopentone) on $F_{1O_2}$ of 50% she achieved $Po_2$ 12.78 kPa, $PCO_2$ 5.64 kPa and pH 7.33. The trachea was extubated and the patient observed overnight. A neurological opinion was sought and the presumptive diagnosis of myotonic dystrophy was confirmed. Subsequent pulmonary function tests demonstrated a severe restrictive ventilatory defect. ECG was unremarkable.

RETROSPECTIVE SURVEY OF THE ABERDEEN ANAESTHETIC EXPERIENCE IN MYOTONIC DYSTROPHY

A search of the literature was prompted by this presentation of apnoea in an undiagnosed myotonic not possessing any features of the commonly quoted triad of frontal balding, testicular atrophy and cataract. A paucity of information exists on the hazards arising from anaesthesia in symptomatic myotonics at the prediagnosis stage; moreover, there has been no comprehensive and systematic review of the risks of anaesthesia in myotonic dystrophy since the only substantial series (Kaufman, 1960) recorded the hazards in the established disease.

In addition to reviewing, collating and summarizing the pertinent literature, the opportunity was taken to review the local experience. The Aberdeen area is well suited for epidemiological studies. The teaching hospital complex possesses a single hospital record system which is of considerable assistance in long-term clinical surveys. Records of the period 1969–1984 were searched and those of inpatients with muscular...
ANESTHETIC PROBLEMS IN MYOTONIC DYSTROPHY

1121

Age at operation
(Mean age 30 yr)

Number of Patients
0 2 4 6 8 10

Age at onset of symptoms
(Mean age 28 yr)

Age when diagnosis made
(Mean age 35 yr)

Fig. 1. Ages of the 17 patients (Aberdeen series) at onset of symptoms, at time of diagnosis and at time of operation.

disease extracted; 154 case records were examined and 38 instances of myotonic dystrophy identified. Seventeen of these patients (nine males) had received one or more general anaesthetic(s) with a total of 49 anaesthetic records being traced; of these 14 were in respect of operations before 1969. At the time of the study all the patients had been assessed and an unequivocal diagnosis of myotonic dystrophy made by a consultant neurologist.

Of the 49 operations, 17 were on the nine males and 32 on the eight females (two patients each required eight operations).

The age at operation (fig. 1) in males was in the range 3-58 yr with a mean of 32.1 yr, and in females 5-49 yr with a mean of 29.7 yr. The mean age at first onset of symptoms was 28.6 yr in both male and female. The age range at the time of diagnosis was 6-52 yr for males (mean 34.8 yr) and 21-48 yr for females (mean 36.3 yr).

Particulars were extracted from each patient's record of the symptoms and signs present at the time of diagnosis (fig. 2), and of the duration of symptoms antedating diagnosis. The disease process was staged at the time of general anaesthetic(s). The anaesthesia and postoperative events were tabulated in detail.

Sex ratio ("1" in figure 2). In accord with all published series, the sex incidence was equal.

Family history (2). Batten and Gibb (1909) reported an affected brother and sister. The disease has, from subsequent series, been established to conform to the criteria for autosomal dominant inheritance with a very low proportion of new mutations (Klein, 1958).

Muscle weakness (3-9). The predominant initial signs arise from ptosis and facial muscle weakness, but the insidious onset is such that by the time of diagnosis the patient may demonstrate a wide variety of symptoms and signs. Cranial and distal muscle weakness predominate.

Myotonia (10). Although myotonia is present in most symptomatic patients, it may be concealed on handshaking by employing a variety of trick manoeuvres (Harper, 1979). The myotonia may
also be reduced by warmth and repetitive movement.

**Balding** (11). Balding was present in 78% of males (mean age 35 yr) and one female (age 48 yr). The rarity of balding even in affected women and its common occurrence in non-affected men make it a poor clinical discriminant of the disease.

**Testicular atrophy** (12). The association of testicular atrophy with myotonic dystrophy has been known since 1909 (Steinert, 1909) and its prevalence has been recorded at 62.8% (Klein, 1958). If present, it is unlikely to be detected by the anaesthetist at preoperative assessment, and unless revealed on routine examination it is unlikely to alert attention to the undiagnosed case.

**Cataract** (13). Cataracts have long been recognized as a feature of myotonic dystrophy (Greenfield, 1911). In the early stages the typical multicoloured subcapsular lens opacities can only be identified by slit lamp examination. When mature, the cataract is indistinguishable from those arising from other causes.

**Endocrine** (14–16). The basis of the endocrine abnormalities recorded in myotonic dystrophy remains unexplained. Abnormal insulin responses to glucose load have been reported in myotonic patients without diabetes (Huff, Horton and Lebowitz, 1967) and the incidence of diabetes may be increased.

Thyroid colloid goitres have been reported (Benda et al., 1954). There was one case of colloid goitre in this series.

**Cardiological** (17). The incidence of ECG conduction abnormalities in myotonic dystrophy has been documented (Church, 1967). The commonest defect is first degree heart block, which affected one patient. A variety of rhythm disturbances have also been documented by Church and two patients in the series exhibited minor atrial arrhythmias.

**Low IQ** (18). Mental abnormalities have been observed in myotonic dystrophy. Although five patients were noted to have low IQ, a number of others were described as "apathetic". Klein (1958) has reported mental deficiency in 22.1% and apathy in 13.1%.

Despite the comparatively small numbers occasioned by the application of general anaesthesia as a selection criterion, the detailed analysis of the symptoms and associated findings at diagnosis reflect an acceptable comparison with the spectrum of disease reported in previously published series.

**Anaesthetics**

Procedures for which the general anaesthetics were given are detailed in table I. All the orthopaedic operations were on males. Two of the three cholecystectomies were on males.

Table II abstracts details of the 49 general anaesthetics administered, detailing premedication and induction and use of neuromuscular blocking maintenance and reversal agents. The complication rate in diagnosed patients was 52% and in undiagnosed patients 35%. The latter has been subdivided between operations undertaken during the symptomatic and the asymptomatic stages of prediagnosis. The complications recorded are presented in table III.

**Grading of Disease (according to Gillam and colleagues (1964))**

 Grade I = mild.
TABLE II. Type of general anaesthetic and problems encountered. ♦ Grade III severity, remainder of patients Grade I and II. ▲ Diagnosis made following anaesthetic complications. Type of problem described by A-H. (see table III). Elsewhere in table: STP = thiopentone; Mxt = methohexitone; γOH = gamma OH; N = nitrous oxide; P = methoxyflurane; E = enflurane; H = halothane; O = oxygen; Sux = suxamethonium; N-D = non-depolarizing muscle relaxant; A = atropine. Neo = neostigmine

<table>
<thead>
<tr>
<th>Premed.</th>
<th>Induction</th>
<th>Relaxants</th>
<th>Maintenance</th>
<th>Reversal</th>
<th>Total no. of GA</th>
<th>Diagnosis known</th>
<th>Symptomatic</th>
<th>Antedating symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>STP</td>
<td>NOH</td>
<td></td>
<td></td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>D</td>
</tr>
<tr>
<td>Opiate</td>
<td>STP</td>
<td>NOH</td>
<td></td>
<td></td>
<td>12</td>
<td>2</td>
<td>4</td>
<td>B + E</td>
</tr>
<tr>
<td>Opiate</td>
<td>Sux</td>
<td>NOH/NO</td>
<td></td>
<td></td>
<td>8</td>
<td>2</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>Opiate</td>
<td>NOH</td>
<td>NOH</td>
<td></td>
<td></td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>G</td>
</tr>
<tr>
<td>Opiate</td>
<td>NOH</td>
<td>NOH +</td>
<td>Extrudural</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Opiate</td>
<td>NOH</td>
<td>NOH</td>
<td></td>
<td></td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>Fd</td>
</tr>
<tr>
<td>Opiate</td>
<td>Mxt</td>
<td>NOH</td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Opiate</td>
<td>Mxt + NOH</td>
<td>NOH/P</td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Opiate</td>
<td>Mxt</td>
<td>NOH/P</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Opiate</td>
<td>Althesin</td>
<td>NOP</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Opiate</td>
<td>γOH + Mxt</td>
<td>NO</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Opiate</td>
<td>Etomidate</td>
<td>NO</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Opiate</td>
<td>STP</td>
<td>Sux N-D</td>
<td>NOH</td>
<td>Althesin</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>C + Fa</td>
</tr>
<tr>
<td>Opiate</td>
<td>Althesin</td>
<td>Sux N-D</td>
<td>NOH</td>
<td>Althesin</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>B + C</td>
</tr>
<tr>
<td>Opiate</td>
<td>STP</td>
<td>N-D</td>
<td>NOH/NO</td>
<td></td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>Fd + Ha</td>
</tr>
<tr>
<td>Opiate</td>
<td>Etomidate</td>
<td>N-D</td>
<td>NOE</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>C + Fa</td>
</tr>
<tr>
<td>Opiate</td>
<td>Althesin</td>
<td>N-D</td>
<td>NO + Althesin infusion</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Fc + Hb</td>
</tr>
</tbody>
</table>

Undiagnosed

| Totals | 49 | 21 | 11 | 14 | 5 | 14 | 0 |

52% Complication rate
35% Complication rate
TABLE III. Types of complication

<table>
<thead>
<tr>
<th>Types of complication</th>
<th>During and immediately after operation</th>
<th>After operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Respiratory depression from opiate premed.</td>
<td>1</td>
<td>F Chest infection</td>
</tr>
<tr>
<td>B Rigidity/very difficult intubation after Sux.</td>
<td>2</td>
<td>(a) Minor</td>
</tr>
<tr>
<td>C Respiratory depression/incomplete reversal following neostigmine</td>
<td>3</td>
<td>(b) With pleural effusion</td>
</tr>
<tr>
<td>D Prolonged apnoea after STP (2.5 h)</td>
<td>1</td>
<td>(c) Pneumonia</td>
</tr>
<tr>
<td>E Prolonged apnoea after STP and Sux (30 min; subsequent STP without respiratory depression)</td>
<td>1</td>
<td>(d) Pneumonia with profound respiratory depression and collapse occurring on 2nd day after op. (both had methadone 10 mg 2–3 h before collapse)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(e) Mild chest infection preceding sudden death 30 h after operation</td>
</tr>
<tr>
<td>Total</td>
<td>8</td>
<td>G Transient generalized muscle weakness</td>
</tr>
</tbody>
</table>

After operation:

F Chest infection
(a) Minor
(b) With pleural effusion
(c) Pneumonia
(d) Pneumonia with profound respiratory depression and collapse occurring on 2nd day after op. (both had methadone 10 mg 2–3 h before collapse)
(e) Mild chest infection preceding sudden death 30 h after operation
G Transient generalized muscle weakness
H Cardiovascular
(a) Myocardial infarction
(b) First degree heart block
Total

Grade II = moderately severe, but patient still able to undertake light work or domestic duties.

Grade III = Patient severely incapacitated, unable to walk far and considered semi-invalid.

Grade IV = Patient bedridden.

No Grade IV patients were identified in this series. Of the six operations recorded on Grade III patients, only one anaesthetic (which used opiate premedication, nitrous oxide, oxygen and halothane for induction, tracheal intubation and maintenance) was without complication. The complications attendant on the other five operations are indicated in Table II. At the time of operation the remaining patients were asymptomatic or Grade I or II in severity.

DISCUSSION

In this series three of the 17 patients (17%) had cholelithiasis. A high incidence of gallstones is a feature of myotonic dystrophy, with an unusual male predominance reported by Robert and colleagues (1972).

Following cholecystectomy, postoperative morbidity and mortality related to respiratory problems is well recognized, with tracheotomy or postoperative ventilation, or both, often being required (Talmage and McKechnie, 1959; Kaufman, 1960; Tsueda, Shibutani and Lefkowitz, 1975; Meyers and Barash, 1976; Buzello, Krieg and Schlickewei, 1982).

Intraoperative/immediate postoperative complications

The complications occurring during and immediately after operation (Table III) were all drug-related: the later postoperative complications tended to reflect the severity of disease.

It is helpful to consider those predictable adverse drug reactions which were related to dosage/disease process, separately from those which were idiosyncratic and occurred unpredictably in a minority of patients (Rawlings and Thompson, 1978).

Thiopentone. Respiratory depression occurred in two patients following the induction of anaesthesia with thiopentone. Both patients were undiagnosed at the time of operation. One patient (Grade II male) had also received suxamethonium following which intubation proved difficult by reason of rigidity. The patient's lungs were ventilated with nitrous oxide in oxygen for 30 min and thereafter recovery was uneventful. Thiopentone was used subsequently in reduced dose without any recorded complication. As the apnoea cannot be unequivocally related to the administration of thiopentone, this patient will not be discussed further.

The second patient is the subject of this case report. She had seven previous operations and on all occasions had received thiopentone (doses varying between 250 and 375 mg); adverse effects were not reported. Seventeen years had elapsed since the last of these operations, although at that time, with hindsight, the patient appeared to have early symptoms of myotonia.

Prolonged apnoea immediately following induction has been reported in myotonic dystrophy (Table IV). On all five occasions the patients had received an opiate premedication. In the Aberdeen series, severe respiratory depression occurred in one patient following opiate premedication, but responded to naloxone before subsequent uncomplicated induction with thiopentone.

In one instance of thiopentone apnoea (Table IV) improvement followed nalorphine (Bourke and Zuck, 1957) but, while it is probable that opiates enhance respiratory depression, clearly thiopentone precipitates the apnoea. In the currently reported case, premedication was with lorazepam which, having a stimulatory effect on respiration
Anaesthetic problems in myotonic dystrophy

TABLE IV. Previous reports of apnoea and respiratory depression following thiopentone

<table>
<thead>
<tr>
<th>Source</th>
<th>Dose of thiopentone (mg)</th>
<th>Duration apnoea (min)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dundee (1952)</td>
<td>500</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td></td>
<td>250</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Bourke and Zuck (1957)</td>
<td>500</td>
<td>120 + Sux 50 mg</td>
<td></td>
</tr>
<tr>
<td>Hewer (1957)</td>
<td>100</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Lodge (1958)</td>
<td>100</td>
<td>40</td>
<td></td>
</tr>
</tbody>
</table>

Depression of respiration following thiopentone

<table>
<thead>
<tr>
<th>Source</th>
<th>Dose of thiopentone (mg)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dundee (1952)</td>
<td>50</td>
<td>No loss of consciousness</td>
</tr>
<tr>
<td>Gillam and others (1964)</td>
<td>100</td>
<td>Increased narcosis in three out of six patients</td>
</tr>
<tr>
<td>Mudge, Taylor and Vanderspek (1980)</td>
<td>100</td>
<td>Apnoeaic but could breathe on command</td>
</tr>
</tbody>
</table>

(Vickers, Schnieden and Wood-Smith, 1984), is unlikely to have contributed to the apnoea.

The mechanism for this apparent sensitivity to thiopentone remains in doubt. Dundee (1952) noted, in his first case, failure of carbon dioxide to stimulate respiration and an apparent return of consciousness before full respiratory volume was restored. In normal muscle the direct stimulant action demonstrated with relatively low concentrations of thiopentone has been shown to be masked with larger doses by the curare-like depression of myoneuronal transmission (Dundee and Wyant, 1974). On the basis of these observations he suggested the involvement of a peripheral mechanism entailing undue sensitivity of the affected musculature to thiopentone.

Depression of respiration with small doses of thiopentone has been recorded (table IV). Gillam and colleagues (1964) felt that the respiratory effect recorded in their series was associated with exaggerated narcosis. Hewer (1957) noted "deep unconsciousness" accompanying the thiopentone-induced apnoea.

In the Aberdeen series (table II) thiopentone was administered on 33 occasions (14 of which antedated the appearance of symptoms) without prolonged apnoea being noted. In Kaufman’s 1960 series, 14 patients received thiopentone without adverse effect. Talmage and McKechnie (1959), Dalal and co-workers (1972), Ravin, Newmark and Saviello (1975) and Tsueda, Shibutani and Lefkowitz (1975) all recorded patients in whom thiopentone was given without adverse effect.

Although these reports suggest that myotonics do frequently show increased sensitivity to the respiratory depressant effects of thiopentone accompanied by an exaggeration of the normal response to narcosis, the prolonged apnoea attributable to thiopentone appears idiosyncratic. Such apnoea is not necessarily associated with CNS depression, and the previous uncomplicated use of thiopentone in the currently reported patient suggests it parallels the development of the disease. In this patient its persistence despite the initial return of consciousness was very similar to Dundee’s experience and implies either, or in combination, a peripheral muscle effect or a remarkably selective depression of the respiratory centre.

It is pertinent that, during the period of apnoea, regular thoraco–abdominal movements were present, with a particularly vigorous abdominal component. The abdominal musculature maintains the intraabdominal pressure, upon which the efficiency of the diaphragm as a muscle of inspiration relies (Grimby, Goldman and Mead, 1976). It may also act as an accessory muscle of inspiration and expiration. The manner in which these movements are co-ordinated with the intercostal/accessory muscles is uncertain (Derenne, Macklem and Roussos, 1978a), but appears to require both input from the respiratory centre and integration at spinal level (Mitchell and Berger, 1975).

Thus, the continued thoraco–abdominal movements, despite their ineffectiveness, suggest functioning respiratory drive. This respiratory effort persisted throughout ventilation. It is unknown whether impairment of the afferent input from the abnormal muscle spindles in myotonic dystrophy (Stranock and Newsom Davis, 1978) has any significant effect on the control of respiratory rhythm, the generation of which has been comprehensively reviewed by Derenne, Macklem and Roussos (1978b). However, the failure of ventilation to inhibit respiratory effort is commonly observed in non-paralysed patients, suggesting that afferent input from lungs and chest wall is of limited importance in the control of human respiration (Widdicombe, 1961; Phillipson, 1978).

Diagnostic clinical patterns of thoraco–
abdominal movement are well recognized (Gold-
man, 1982). Active inward (paradoxical) move-
ment of the abdomen in inspiration occurs in
obstructive airways disease and respiratory muscle
fatigue arising from either central or peripheral
causes (Ashutosh et al., 1975; Macklem, 1980).
Myotonia of the intercostal muscles has been
recorded (Benaìm and Worster-Drought, 1954).
Passive abdominal movements may occur across
a paralysed diaphragm (Macklem, 1980) and have
been observed in quadriplegics with upper
cervical lesions (Sharp et al., 1977). Diaphragmatic
paralysis is responsible for the “seesaw” respira-
tion of Stage III Plane IV ether anaesthesia
(Guedel, 1951). In myotonic dystrophy, muscle
fatigue (Roussos and Macklem, 1977) and myotonia
(Kilburn, Eagen and Heyman, 1959) have been
shown to affect the diaphragm.
In this case the ineffective ventilation in
the presence of an intact respiratory drive appears
likely to have arisen primarily from muscle
dysfunction and would appear to support Dundee's
original postulation of an idiosyncratic peripheral
effect of thiopentone.
Suxamethonium. Myotonic muscle displays in-
creased sensitivity to suxamethonium (Orndahl
and Stenberg, 1962). This may exacerbate the
myotonia, causing respiratory muscle spasms and
consequent anoxia.
In the Aberdeen series two symptomatic
patients (16%) became rigid following suxa-
methonium, making intubation very difficult. One
of these patients when asymptomatic some 8 years
previously, had received suxamethonium in a
similar dose without ill effect.
In the animal model, suxamethonium has been
shown to increase serum potassium concentration
(Paton, 1956). An increase in plasma potassium
concentration has been demonstrated to bring
about a parallel increase of muscular excitability in
normal individuals. In patients with myotonic
dystrophy it is associated with a bi-phasic
phenomenon, the severity of the myotonia being
initially decreased and then, at higher potassium
concentrations, being markedly increased with the
occurrence of spontaneous myotonic discharges
(Durelli et al., 1982, 1983). It has been suggested
that the increase in potassium concentration may
form the basis of the adverse reaction to
suxamethonium. Certainly, in conjunction with
the bi-phasic phenomenon, it may explain the
unpredictable nature of the response in myotonic
dystrophy. However, if this explanation is valid,
the reaction is not idiosyncratic and all myotonic
patients must be considered at risk if there is a
sufficiently marked increase in serum potassium
concentration.
Thiel (1967), from an extensive review, con-
cluded that depolarizing neuromuscular blocking
drugs are best avoided, and that non-depolarizing
drugs are not contraindicated, provided there is an
appreciation of the importance of adequate
antagonism in the presence of muscular wasting
and weakness.
Neostigmine. In three symptomatic patients
(33%) in whom neostigmine was used to reverse
non-depolarizing block, incomplete reversal was
reported. The first patient was a 40-yr-old female
(Grade II) who, after cataract surgery and
following neostigmine 3.75 mg, complained of
difficulty in breathing and required doxapram.
Five months previously, at the time of choled-
cystectomy, this patient had received pyridostig-
mine 10 mg. Although postoperative breathing
difficulties were not recorded, she did require a
second dose of 4 mg.
The second patient was a 43-yr-old male (Grade
III) who, following an appendicectomy, received
initially neostigmine 5 mg and subsequently a
further 2.5 mg. Difficulty in reversal was noted,
reintubation of the trachea being required.
The third patient was a man of 40 yr with Grade
II disease who, after anterior spinal fusion and
reversal of tubocurarine with neostigmine 5 mg,
was noted to have poor colour and breathing
difficulties.
In 1937 Kennedy and Wolf reported increased
myotonia following the use of neostigmine.
Myotonic muscle has increased sensitivity to the
stimulating effects of acetylcholine and choline
(Orndahl, 1962). It has been demonstrated, in
patients with normal muscles, that the neuro-
muscular paralysing action of neostigmine in the
presence of a competitive blocking agent was
increased when given in two sequential doses of
2.5 mg compared with a single dose of 5 mg. These
findings indicate that, despite initial reversal with
neostigmine, subsequent doses may, by acting on
normal unblocked muscle, produce acetylcholine-
induced depolarization blockade. It is postulated
that apparent instances of inadequate reversal may
have been attributable to overdosage with neo-
stigmine (Payne, Hughes and Al Azawi, 1980).
A patient with myotonic dystrophy has been
reported in whom attempts to antagonize residual non-depolarizing blockade with neostigmine were only partially effective and a further dose produced long-lasting muscular weakness which, on train-of-four response, resembled depolarization blockade. The precise mechanism remains unclear, but did not appear to be simply related to excess acetylcholine at the motor end-plate. The authors concluded that it was not possible to predict the type and degree of response to neostigmine. It was suggested, furthermore, that any anticholinesterase agent may be suspect and concern was expressed over the use of neuromuscular blocking drugs. If the use of such drugs is essential, the authors suggested that the shorter acting agents be utilized and any residual curarization dealt with by mechanical ventilation (Buzello, Krieg and Schlickewei, 1982).

Aldesin. In one patient in the present series an Aldesin infusion was utilized (male age 27 yr with Grade II disease) without complication. Suppan (1975) and subsequently Muller and Suppan (1977) reported the efficacy of an Aldesin infusion plus pancuronium where either atrophy or myotonia was the major feature. Yee, Milliss and Lah (1981) have recorded an uneventful outcome using an infusion of Aldesin.

Halothane. It has been postulated that the use of halothane may be potentially disadvantageous, in that myotonia could be precipitated by postoperative shivering (Thiel, 1967). This has not been recorded in the present series.

Later postoperative complications

Chest infections. Chest infections arising from muscle weakness and possibly aspiration affected 20% of the patients. The incidence reflected the severity of the disease, no complications occurring in the undiagnosed antedating symptoms group, two (14%) in the symptomatic undiagnosed group and eight (38%) in the diagnosis-known group. Despite the expected increased numbers of cholecystectomies in the overall spectrum of operations performed (table I), the latter incidence is clearly of significance for this relatively young group of patients (fig. 1).

Direct involvement of pulmonary or bronchial tissue by the disease process has not been demonstrated, but indirect involvement is of considerable importance and the cause of significant morbidity and mortality. Weakness and myotonia in both pharynx and oesophagus cause defective swallowing, giving rise to frequent tracheal aspiration and, in patients in whom there is also respiratory muscle weakness, resulting in pulmonary lung changes (Garrett et al., 1969).

Involvement of the diaphragm has been recorded at autopsy (Londres, 1935). Radiological studies have shown that the diaphragmatic abnormality is caused not only by weakness and atrophy, but also by myotonia (Kilburn, Eagen and Heyman, 1959). Myotonia of the intercostal muscles has been recorded by Benaim and Worster-Drought (1954). Early respiratory muscle weakness is common and disproportionately greater than weakness elsewhere (Serisier, Mastaglia and Gibson, 1982). Kilburn and co-workers (1959), measuring minute ventilation, reported that patients affected with myotonic dystrophy showed decreased responsiveness to hypercapnia and suggested the possibility of central respiratory centre depression, although Gillam and colleagues (1964) were unable to confirm this observation. Carroll and associates (1977) showed that, in several mildly affected patients, the ventilatory response to hypoxia was uniformly reduced, but only two patients showed a reduced response to hypercapnia. It was postulated that brain stem neuroregulatory mechanisms were at fault.

The control and modulation of respiration in patients with myotonic dystrophy has been reassessed by Bégin and colleagues (1980), using mean inspiratory flow rate and occlusion pressure measurements which are less affected by the mechanics of breathing than the measurements of minute volume used by previous investigators. The responses of 12 myotonic patients and 12 control patients to selective stimulation of the chemical drive of breathing (using hypercapnia, isocarbic hypoxia and hyperoxia) were compared. In responding to hypercapnia, myotonic dystrophy patients had a normal occlusion pressure but reduced ventilatory output, composed of a smaller tidal volume with a higher respiratory frequency. The results of the hypoxia test demonstrated a significant increase in ventilatory output in both patients and controls, the only difference being the pattern of breathing, characterized by a small tidal volume and higher frequency in myotonic dystrophy patients. Again in the hyperoxia tests, no differences between patients and controls were apparent, indicating that both peripheral and central chemoreceptors are well preserved in myotonic dystrophy. The patients entering this
study were moderately affected by the disease process and caution should be exercised in extrapolating the results to severe disease. However, it would appear that many of the observations recorded by previous investigators in Grade II patients may have reflected muscle dysfunction rather than the integrity of the respiratory centre. Bégin and colleagues (1982) subsequently investigated the ventilatory performance of a group of 10 patients with moderate disease. They demonstrated that the ventilatory output was altered predominantly by weakness and fatiguability of the respiratory muscles during higher ventilatory performance and by increased impedance of the respiratory system at lower degrees of ventilation.

**Sudden death.** It seems likely that sudden death, which is not uncommon in the disease, arises from cardiovascular causes. Asymptomatic ECG abnormalities are common and changes consistent with cardiac damage are shown in 60% of patients studied by vectorcardiography; cardiomyopathy has been identified in more than 50% of patients studied at postmortem (Feareington, Gibson and Churchill, 1964). The 30-yr-old female in the Aberdeen series with Grade II disease, died 30 h after laparotomy for bilateral oophorectomy. A minor chest infection was reported after operation. This was her eighth general anaesthetic and her fourth since the diagnosis had been made 7 yr before death. Other problems recorded with previous anaesthetics were respiratory depression following opiate premedication, and on a separate occasion a minor chest infection. Autopsy revealed lung congestion without any obvious cardiac lesion, but unfortunately no preoperative ECG was available for examination. The patient had an affected brother who collapsed and died suddenly at the age of 29 yr.

**CONCLUSION**

The high incidence of cataract and gallbladder disease in myotonic dystrophy renders the patients as a group more liable to exposure to general anaesthesia. In the patients reviewed, in the literature and from the present series, it can be seen that many of the difficulties have arisen as a result of either the diagnosis of myotonic dystrophy not being made before operation or underestimating the hazards of respiratory insufficiency.

The case has been reported in detail to illustrate the difficulties attendant on making an early diagnosis in a disease with such insidious onset, and further amplification of the difficulties is not required.

In known patients local anaesthesia should be used if possible, especially in patients with Grade III or IV disease. Myotonic dystrophy is not an absolute contraindication to general anaesthesia, provided the risks are anticipated and steps taken to minimize the complications.

A suggested outline of an appropriate technique of general anaesthesia, based on this survey, is given below.

**APPENDIX**

**IMPLICATIONS FOR ANAESTHETIC MANAGEMENT**

**Anaesthetic drugs**

- **Thiopentone.** Avoid or only minimal dose (not more than 100 mg); preferable to use gaseous induction or etomidate.
- **Suxamethonium.** Avoid altogether; often jaw is weak and it is possible to intubate without neuromuscular blocker.
- **Non-depolarizing agents.** Preferable to use new short acting agents such as atracurium or vecuronium.
- **Neostigmine.** With care!; may be better to ventilate until residual curarization wears off.
- **Opiates.** Restrict dose to avoid respiratory depression. Monitor the action of any respiratory depressant drugs carefully.

**General management**

- **Pre-operative assessment.** ECG, pulmonary function tests and blood-gas tension.
- **During operation.** Monitor ECG and arterial pressure; use a peripheral nerve stimulator to monitor neuromuscular blockade.
- **After operation.** Early physiotherapy; monitor respiratory adequacy; assist ventilation early if inadequate. It may be prudent to leave the endotracheal tube in situ until maximal muscle power has been regained and the anaesthetic effects diminished.
- Tracheotomy may be required to control secretions if cough reflex is reduced.
- Treat infections vigorously.
- Keep patient warm and calm, as cold and emotional excitement increase myotonia.

In patients in whom hypoxic drive accompanies chronic ventilatory failure, controlled oxygen therapy should be used.
Management of myotonia

Myotonia as a result of surgical stimulus is not abolished by spinal block or tubocurarine, but can be obtunded by injecting procaine to the muscles (Landau, 1952). Severe troublesome myotonia may be treated by quinine hydrochloride 300–600 mg i.v. (Kaufman, 1960).

ACKNOWLEDGEMENTS

My thanks to Dr A. W. Downie, Consultant Neurologist, for his encouragement, helpful suggestions and access to the records of his patients, and to my colleagues in the department both past and present for their diligence in completing the anaesthetic records in such helpful detail.

REFERENCES


---


---


