DYSRHYTHMIA AND ORAL SURGERY

BY

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SUMMARY

Two hundred and three male patients undergoing oral surgery were monitored for abnormalities of cardiac rhythm. Eight per cent of a smaller number of patients (seventy-six) developed ectopic rhythms during induction of anaesthesia and in half of all patients nodal rhythm was seen. Twenty-three per cent developed ectopic rhythms in response to surgery. In three per cent of patients these were of the "chaotic" type. Most of the ectopic rhythms were nodal (supraventricular) in origin. Stimulation of the sympathetic system via the fifth cranial nerve in the presence of halothane anaesthesia is considered to be the main factor in the production of these dysrhythmias. Their significance is discussed.

Operations.

The operations performed were routine oral surgical procedures including the removal of impacted wisdom, unerupted canine or supernumary teeth, multiple extractions, enucleation of cysts, and 7 cases of interdental wiring for fractured jaw. The majority of operations lasted 1 hour or more.

Monitoring.

Cardiac rhythm was continuously monitored with a Cardiorater oscilloscope and intermittently recorded using a Miniwriter pen recorder (Cardiac Recorders Ltd). The standard lead II was usually employed using multipoint electrodes. In the first 127 patients monitoring was started after the patient was anaesthetized, and in the last 76 cases before the induction agent was given.

RESULTS

Table I shows the percentage incidence of ectopic rhythms in response to surgery, as indicated by the appearance of premature or extrasystolic complexes on the oscilloscope. The percentage of patients who developed ectopic beats clearly increased with age, although there was no obvious correlation between age and the incidence of ectopics arising from more than one

In spite of two annotations in the Lancet (1966, 1969) and a number of papers published in recent years (Kaufman, 1965, 1966; Tuohy, 1968; Ryder, 1970, 1971; Miller et al., 1970), it is still not widely appreciated by anaesthetists and oral surgeons that cardiac dysrhythmias occur frequently during oral surgery performed under general anaesthesia, both in hospital and ambulant patients. This subject is obviously worthy of further study, and the present investigation was undertaken to assess the frequency, type and potential seriousness of these dysrhythmias in a group of in-patients.

METHODS

Two hundred and three male in-patients were studied. All were physically fit apart from 7 with heart disease. Their ages ranged from 13 to 71 (table I) and all were premedicated with pethidine 50–75 mg according to weight and atropine 0.6 mg. Anaesthesia was induced with propanidid, methohexitone or thiopentone with suxamethonium 50 mg to aid nasal intubation. The throat was packed and anaesthesia maintained with nitrous oxide 5 l./min and oxygen 3 l./min via a Magill circuit with halothane (2 per cent reducing to 1 per cent or less) from a Fluotec vaporizer, ventilation being spontaneous on recovery from the suxamethonium. The patients were supine throughout. All anaesthetics were administered by the author.

site in the heart (multifocal ectopic rhythms). Table II indicates the percentage incidences of other electrocardiographic changes.

**Induction tachycardia.** In the 76 patients in whom cardiac rhythm was monitored during the induction of anaesthesia (table II) transient sinus tachycardia was common, and the heart rate increased even further by intubation. Nodal rhythm was seen in half the 203 patients, being preceded by sino-nodal allorhythmia (wandering or sometimes inverted P wave). These changes occurred soon after induction of anaesthesia, and were associated with the higher levels of halothane. Bradycardia of less than 60 beats/min was seen in 10 per cent of patients after the induction period, usually when being given 2 per cent halothane.

Heart rate always increased once surgery was started. Tachycardia of 120 beats/min or more was noted during surgery in 23 per cent of patients (table III), and here there was an obvious correlation with age, being seen in 33 per cent of the patients in the 10-19 age group and not at all in the 60-71 age group. No patient aged 40 or more developed a heart rate of 150 beats/min.

Table IV shows the percentage incidence of dysrhythmia during induction of anaesthesia and during surgery. Of the 76 patients whose anaesthesia induction was monitored, ectopics were noted in 8 per cent, half with less than 20 and half with more than 20 ectopic beats. These disappeared once a stable level of anaesthesia with spontaneous respiration was reached, but in two-thirds ectopics were again noted once surgery was started. Of the 23 per cent in whom surgery induced ectopic rhythms, 6 per cent had between 1 and 20 and the remaining 17 per cent more than 20 ectopic beats. The duration of the latter varied from a few minutes to up to 30 minutes in a few patients, but tended to reduce in frequency with time or successive extractions.

It should be noted here that in 16 patients the pulse felt regular while ectopic rhythms were occurring. In 8 these were multifocal and in 2 the record was chaotic. One was surprised on occasion at the minor nature of the stimulus required to produce dysrhythmia. Figure 1 (trace 1a) shows the nodal ectopics which appeared in a 21-year-old man diagnosed as having the Kleine Levin syndrome (periodic hypersomnia and excessive appetite) when the sucker was

### TABLE I

<table>
<thead>
<tr>
<th>Age group</th>
<th>10-19</th>
<th>20-29</th>
<th>30-39</th>
<th>40-49</th>
<th>50-59</th>
<th>60-71</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients</td>
<td>54</td>
<td>78</td>
<td>36</td>
<td>17</td>
<td>11</td>
<td>7</td>
<td>203</td>
</tr>
<tr>
<td>Multifocal ectopic rhythms</td>
<td>6</td>
<td>6</td>
<td>14</td>
<td>24</td>
<td>9</td>
<td>14</td>
<td>9</td>
</tr>
<tr>
<td>Total ectopic rhythms</td>
<td>20</td>
<td>14</td>
<td>22</td>
<td>35</td>
<td>46</td>
<td>71</td>
<td>23</td>
</tr>
</tbody>
</table>

### TABLE II

**Percentage incidence of electrocardiographic changes unrelated to surgery. Figures in brackets indicate total number of cases.**

<table>
<thead>
<tr>
<th>Induction tachycardia (beats/min):</th>
<th>&gt;120</th>
<th>&gt;150</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methohexitone (40)</td>
<td>55</td>
<td>15</td>
</tr>
<tr>
<td>Propanidid (30)</td>
<td>60</td>
<td>12</td>
</tr>
<tr>
<td>Thiopentone (6)</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Nodal rhythm (203)</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>Bradycardia Sinus</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Bradycardia Nodal</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

### TABLE III

**Percentage incidence of tachycardia during surgery (203 patients).**

<table>
<thead>
<tr>
<th>Sinus tachycardia</th>
<th>17</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nodal tachycardia</td>
<td>6</td>
<td>1</td>
</tr>
</tbody>
</table>

### TABLE IV

**Percentage incidence of dysrhythmia during induction (76 patients) and surgery (203 patients).**

<table>
<thead>
<tr>
<th>Atrial</th>
<th>Induction</th>
<th>Surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Unifocal nodal</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Multifocal nodal</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Ventricular</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>8</td>
<td>23</td>
</tr>
</tbody>
</table>

6 patients had chaotic dysrhythmias (3%).
A man of 21 diagnosed as having the Kleine Levin syndrome (periodic hypersomnia and excessive appetite) developed ectopic beats when the sucker was placed in his mouth.

The record became chaotic during exposure of a wisdom tooth. (Paper speed 25 mm/sec.)

Bifocal nodal ectopics during interdental wiring for fractured jaw.

Nodal ectopics on applying forceps to a tooth in a 62-year-old man with ischaemic heart disease. (Paper speed 10 mm/sec.)

placed in his mouth. The record became chaotic (multifocal nodal ectopics) during exposure of a wisdom tooth (trace 1b). This figure also shows (trace 2) bifocal nodal ectopics during interdental wiring for a fractured jaw.

Heart disease. Seven patients in this series had known or suspected heart disease, 2 rheumatic and 5 ischaemic. Trace 3 of figure 1 shows a run of unifocal nodal ectopics in a 62-year-old man when a tooth was grasped with forceps. This was repeated several times. A few ventricular ectopics were noted in 2 other patients with ischaemic heart disease. The remaining patients had no disturbance of normal rhythm.

Treatment.
Although all authors are agreed that these abnormal rhythms will disappear on cessation of surgery, the surgeon was not asked to stop the operation in the presence of dysrhythmia in the present series since the objective was to mimic as closely as possible the conditions under which most oral surgery is undertaken, i.e. without e.c.g. monitoring. However, if the dysrhythmia was multifocal in origin and particularly if it was chaotic (trace 1b) or lasted for more than 5 minutes, an intravenous injection of either lignocaine 50–100 mg, propranolol 1 mg or droperidol 5–10 mg was given. Table V shows

<table>
<thead>
<tr>
<th>Drug used</th>
<th>No. of cases</th>
<th>Results on ectopics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propranolol</td>
<td>3</td>
<td>Abolished</td>
</tr>
<tr>
<td>Droperidol</td>
<td>6</td>
<td>Abolished</td>
</tr>
<tr>
<td>Lignocaine</td>
<td>3</td>
<td>Reduced number</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>No effect</td>
</tr>
</tbody>
</table>

that in the doses used, both propranolol and droperidol were effective in abolishing the dysrhythmia (although the latter was associated with marked falls in systolic pressure in some patients), whereas lignocaine was relatively ineffective. In one patient in whom lignocaine was effective, nodal rhythm was produced with marked slowing of the heart rate.

DISCUSSION
The data show a high incidence of nodal ectopic rhythms during oral manipulations which in other reported series vary between 18 and 75 per cent. The incidence agrees closely with that listed in table VI, apart from that of Miller et al. (1970). They, however, included all electrocardiographic changes, and when one considers that 51 per cent of patients in this series developed nodal rhythm at some period during their anaesthesia, their results are not very different.

In a similar survey, Ryder (1970) quoted a 25 per cent incidence in a series reported by Tolas and associates (1967). However, the latter workers were dealing only with the induction of anaesthesia and the protective effect of thiopentone against dysrhythmia during this time.
TABLE VI
Comparative incidence of dysrhythmia in recently reported series during nitrous oxide-oxygen-halothane anaesthesia. Tuohy (1968) and this series dealt with in-patients while the other authors described their findings with out-patients.

<table>
<thead>
<tr>
<th>Author</th>
<th>Incidence of reported dysrhythmia (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuohy (1968)</td>
<td>27</td>
</tr>
<tr>
<td>Rollason and Dundas (1968)</td>
<td>18</td>
</tr>
<tr>
<td>Miller et al. (1970)</td>
<td>75*</td>
</tr>
<tr>
<td>Ryder (1970)</td>
<td>34*</td>
</tr>
<tr>
<td>Ryder (1971)</td>
<td>33</td>
</tr>
<tr>
<td>This series</td>
<td>23</td>
</tr>
</tbody>
</table>

*Includes all e.c.g. changes including those observed prior to surgery.

The high incidence of nodal rhythm and bradycardia can be ascribed to halothane and was noted by Johnstone (1956).

Tuohy (1968) lists atropine, hypoxia, hypercarbia and surgical stimulation as factors producing abnormalities of cardiac rhythm under general anaesthesia. Halothane is known to have a similar effect, possibly by sensitizing the myocardium to the action of catecholamines (Katz and Katz, 1966).

Since the patients in the present series were maintained in a light plane of anaesthesia, neither hypoxia nor hypercarbia is likely to have been a factor. Miller and associates (1970) consider underventilation to be important in the production of ventricular dysrhythmias. As table IV shows, ventricular ectopics were not common, and those seen were isolated or infrequent.

Atropine does not seem to be important—the incidence of dysrhythmia was similar in Ryder’s (1970) series in which no patient had atropine, and in Tuohy’s (1968) patients who all had atropine.

Stimulation of the fifth cranial nerve is reputed to stimulate the sympathoadrenal system (Ballantine and Jackson, 1960; Hunter, 1964). It is worth noting that 7 of 18 patients developing multifocal nodal ectopics in this series responded to surgical stimulation with heart rates rising to 120 beats/min or more before the abnormal rhythm appeared. Sympathetic stimulation would seem under these circumstances to provoke ectopic sites in the junctional system of the heart. The presence of endogenous adrenaline may also play a part.

It must be stressed again that in 16 patients the pulse felt regular while ectopics were occurring. In 8 these were multifocal and in 2 the record was chaotic. Only the monitor gave an indication that an abnormal rhythm was occurring. Pulse volume felt adequate at all times. Some authors consider that ectopic rhythms arising during dental anaesthesia are ventricular in origin. A careful examination of the electrocardiograms published by Ryder (1970) and Tuohy (1968) leads to the conclusion that most of the ectopic rhythms which have been termed ventricular are in fact nodal in origin. In figure 2 (trace 4) is an example of a nodal bidirectional tachycardia with fusion beats in a fit graduate aged 28 during removal of an unerupted wisdom tooth. Trace 5a shows a chaotic dysrhythmia in a 35-year-old man having a similar operation. Lignocaine 100 mg intravenously did not abolish

![Fig. 2](attachment:image)

4. Nodal bidirectional tachycardia with fusion beats in a fit graduate aged 28 during removal of a buried wisdom tooth.

5a. Chaotic type of nodal tachycardia in a 35-year-old man having a similar operation. This could be mistaken for multifocal ventricular ectopics.

5b. The same patient soon after the injection of lignocaine 100 mg intravenously, which did not abolish the dysrhythmia but slowed the rate sufficiently for abnormal P waves to be made out, indicating that the ectopics are nodal in origin.
the ectopic beats but slowed the ventricular rate sufficiently for abnormal P waves to become apparent (trace 5b), indicating the nodal origin of the dysrhythmia, associated here with aberrant intraventricular conduction.

Lignocaine is enjoying considerable popularity at present in the treatment of ventricular ectopies and ventricular tachycardia (Spracklen et al., 1968). The fact that its use was relatively ineffective in abolishing dysrhythmias in this series would support the suggestion that the majority of these ectopies are not ventricular in origin. Kaufman (1965) also noted the refractoriness of the dysrhythmia to lignocaine in one of his patients. Propranolol, with its negative inotropic effects, is not considered a safe drug for routine use during anaesthesia (Johnstone, 1965). It is of more benefit in the treatment of nodal or supraventricular ectopies and was effective in the few patients in whom it was used. Droperidol, the third anti-arrhythmic drug used, is claimed to have mild alpha-adrenergic blocking properties and exerts a protective influence against adrenaline-induced cardiac dysrhythmias during anaesthesia (Long, Dripps and Price, 1967). Its effectiveness in abolishing ectopies in all the patients to whom it was given in this series would suggest that it also has an appreciable beta-blocking action. Unfortunately, its use was associated with a sharp fall in systolic blood pressure in a few patients, which was not seen with either propranolol or lignocaine. Morton (1971, personal communication) considers nodal ectopies to be benign, except in patients with ischaemic heart disease. Nodal rhythm, which was seen in half the patients in this series, may cause a fall in cardiac output (Laver and Turnford, 1963).

The effects of these dysrhythmias on a hypoxic heart, or one depressed by anaesthetic drugs or subject to the effects of a high level of endogenous adrenaline in the nervous patient, is a matter for speculation. The influence of the sitting position for out-patient dental surgery, is also unknown, but it is not difficult to believe that falls in cardiac output could occur and be responsible for some of the cases of fainting described by Bourne (1970).

There were no cases of delayed recovery from anaesthesia in this series in spite of prolonged dysrhythmia in a few cases, which suggests that any harmful effect due to dysrhythmia is minimized in the recumbent position.

ACKNOWLEDGEMENTS

I am grateful to Professor J. W. Dundee for his advice and criticism in the preparation of this paper, to Mr C. McKay for access to his patients, and to Drs P. Morton and S. Bekheit of the Cardiological Investigation Department of the Belfast City Hospital for their help in interpreting the electrocardiograms.

REFERENCES

Deux cent et trois patients masculins, subissant une intervention chirurgicale orale, ont été contrôlés du point de vue des anormalités éventuelles du rythme cardiaque. Huit pourcent d’un groupe de patients plus petit (soixante-seize) ont développé un rythme ectopique au cours de l’induction d’anesthésie et on observa chez la moitié de tous les patients un rythme nodal. Vingt-trois pourcent ont manifesté un rythme ectopique en réaction à la chirurgie; ce rythme fut du type “chaotique” chez trois pourcent des patients. L’origine de la plupart des rythmes ectopiques fut nodale (supraventriculaire). Une stimulation du système sympathoadrénergique via le 5ème nerf cranial en présence de l’anesthésie à l’halothane est considéré comme le principal facteur dans la production de ces dysrythmies. Leur importance est discutée.

RHYTHMUSSTÖRUNGEN UND MUNDCHIRURGIE

ZUSAMMENFASSUNG


DISRITMIA Y CIRUGIA ORAL

RESUMEN

Doscientos tres pacientes varones sometidos a cirugía oral fueron monitorizados para las anomalías del ritmo cardiaco. El ochenta por ciento de un número menor de pacientes (setenta y seis) desarrollaron ritmos ectópicos durante la inducción de la anestesia y en la mitad de todos los pacientes se observó un ritmo nodal. El veintitrés por ciento desarrollaron ritmos ectópicos en respuesta a una operación quirúrgica. En el tres por ciento de los pacientes fueron de tipo “caótico”. La mayoría de los ritmos ectópicos tenían un origen nodal (supraventricular). Se considera que la estimulación del sistema simpato-adrenal por vía del 5º nervio craneal durante la anestesia por halotano es el factor principal en la producción de estas disritmias. Se discute su importancia.

MIDLAND SOCIETY OF ANAESTHETISTS

Programme for 1971/1972

1971

NOVEMBER 11, at the Postgraduate Centre, Dudley Road Hospital: “The Faculty Training Project” by Dr M. D. Vickers

1972

FEBRUARY 3, at the Birmingham Maternity Hospital: Registrars’ Papers

APRIL 18, at the Postgraduate Centre, Ronkswood Branch of Worcester Royal Infirmary: “The Nurse Anaesthetist” by Dr R. S. Lambie, Dr B. H. Smith, and Dr P. J. Tomlin

The above meetings will start at 8 p.m. and there will be a buffet beforehand from 6.30 p.m.

JUNE 17, Ali-Day Meeting at Warwick Hospital details of which will be circulated nearer the date.